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UNIVERSITY OF ALBERTA

# INJURIES IN EDMONTON RUGBY UNION: AN EPIDEMIOLOGICAL STUDY

BY

**LEIGH GARVIE**

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE.**

**DEPARTMENT OF PHYSICAL THERAPY**

EDMONTON, ALBERTA

FALL 1992

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Dr. David Magee (Supervisor)

Mr. Sandy Rennie

Dr. Sharon Warren

Dr. Tom Maguire

June 2, 1992

## DEDICATION

This thesis is dedicated to my husband, Grant Andruchow, who supported me throughout this endeavor and helped me through more than one meltdown; and to my parents, Wilbur and Judy Garvie, who always encouraged me to reach my full potential.

**ABSTRACT**

INJURIES IN EDMONTON RUGBY UNION

Rugby is considered a high risk sport with many factors affecting incidence of injury. These factors vary in different countries and climates, and their identification lead to changes in the laws of rugby making it a safer game. There have been no studies on these factors in Canadian rugby.

This study has established a baseline of data on incidence of injuries in Canadian Prairie rugby including frequency, nature, severity and mechanism of injury, which occurred in a season of first division club play, and senior representative level of rugby union games in Edmonton, Alberta, Canada.

The rate of injury was 8.86% for first division games and 11.44% for representative team games. The most common cause of injury was a direct blow.

Sprains were the most common injury, followed by contusions, lacerations and strains. The most common location of injury was the head, followed by the knee and ankle.

Injuries were of a minor nature as most players completed the game they were injured in, and missed only one or two weeks future practice or game time.

Injuries peaked in mid-season (July), and during the second and fourth quarters of the game.

There were few cervical spine injuries and they were not

serious injuries as most of the injured players were able to complete the game and did not miss any future games. They were most frequently caused by a direct blow or overstretching, and occurred during rucks/mauls or tackling. Set scrummaging was not a cause of cervical spine injuries. They occurred mainly during the second half of the game.

Being tackled and rucks/mauls caused the most injuries. The injuries occurred evenly among forwards and backs. Change of player position and playing with a pre-existing injury were not risk factors for injury.

Mouthguard wearers suffered less concussions and loss of consciousness, and lost less time from the game than non-wearers.

Most injuries were sustained on hard, dry fields, but most games were played under these conditions.

There were no significant differences between injured and noninjured players in profile, position played or preseason training.

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**TABLE OF CONTENTS**

**PAGE**

I. PROBLEM STATEMENT

A) Introduction.....1

B) Purposes of this Study.....2

C) Relevance of this Study.....3

D) Delimitations.....4

E) Limitations.....5

F) Definition of Terms.....6

II. LITERATURE REVIEW.....9

1. Injury Factors .....10

2. Game Factors.....17

3. Risk Factors.....18

4. Influence of Playing Surfaces on Injuries.....24

5. Summary.....26

III. METHODS AND PROCEDURES

1) Population and Sample.....27

2) Study Design.....29

3) Data and Instrumentation.....29

4) Analysis of the Data.....34

IV. RESULTS

1) Baseline Data.....35

2) Game Factors.....50

3) Risk Factors.....53

4) Injuries by Field Conditions.....80

5) Injured vs Noninjured Player Profile.....82

6) Summary and Conclusion.....86

7) Recommendations.....91

BIBLIOGRAPHY

**GUIDE TO APPENDICES**

APPENDIX A: EDMONTON RUGBY INJURY REPORT FORM

APPENDIX B: LETTERS OF SUPPORT

APPENDIX C: FORMULAE

APPENDIX D: GUIDELINES TO QUESTIONNAIRE

APPENDIX E: LETTER TO EDMONTON RUGBY UNION

APPENDIX F: CONSENT FORM

## LIST OF TABLES

Page

Table I: Nature of injuries found by various epidemiological studies.....14

Table II: Location of injuries found by various studies.....16

Table III: Phase of play/percentage of injury occurrence found by various studies.....20

Table IV: Injury occurrence by various player position for various studies.....22

Table V: Player profiles.....36

Table VI: Percentage of future practices lost due to injuries occurring on various field conditions...81

Table VII: Percentage of future games lost due to injuries occurring on various field conditions.....82

Table VIII: Comparison of injured forwards and backs for first division and representative players.....84

Table IX: Comparison of percentage of injured representative players and first division players.....85

Table X: Percentage of injured players by preseason training.....85

## LIST OF FIGURES


Page

Figure 1: Cause of injuries.....39

Figure 2: Nature of injuries.....41

Figure 3: Anatomical location of injuries for central body areas.....42

Figure 4: Anatomical location of injuries for upper extremity.....43

Figure 5: Anatomical location of injuries for lower extremity.....44

Figure 6: Anatomical location of injuries for general areas.....45

Figure 7: Time lost from game due to injury.....47

Figure 8: Time lost from future practices due to injury....48

Figure 9: Time lost from future games due to injury.....49

Figure 10: Injury occurrence by month of play.....50

Figure 11: Injury occurrence by time in game.....52

Figure 12: Nature of cervical spine injuries.....53

Figure 13: Cervical spine injuries by position played.....54

Figure 14: Cause of cervical spine injuries.....55

Figure 15: Phase of play causing cervical spine injury.....56

Figure 16: Occurrence of cervical spine injuries by time in game.....57

Figure 17: Time lost due to cervical spine injury.....58

Figure 18: Phase of play causing injuries.....59

Figure 19: Percentage of total injuries for positions played.....61

Figure 20: Percentage of players injured for each position.....62

Figure 21: Nature of injuries for forwards.....63

Figure 22: Location of injuries for forwards.....64

Figure 23: Cause of injury for forwards.....65

Figure 24: Nature of injuries for backs.....67

Figure 25: Location of injuries for backs.....68

Figure 26: Cause of injuries for backs.....69

Figure 27: Anatomical location of injuries for player groups.....71

Figure 28: Injuries occurring with pre-existing injury.....72

Figure 29: Mouthguard use by head/face injured forwards....75

Figure 30: Mouthguard use by head/face injured backs.....76

Figure 31: Nature of head/face injuries with and without mouthguard use.....77

Figure 32: Cause of head/face injuries with and without mouthguard use.....78

Figure 33: Phase of play causing head/face injuries with and without mouthguard use.....79

Figure 34: Time lost from game due to head/face injuries with and without mouthguard use.....80

## I) PROBLEM STATEMENT

### A) INTRODUCTION

Rugby is considered a high risk sport with a high incidence of injury. Frequency of injury is related to many things, including player skill and technique, player fitness, fatigue, level of competition, and external influences such as playing field conditions, weather, and size and skill of opponents.

Historically, rugby began in 1823 when a school boy at Rugby School in England disrupted a soccer game by picking up the ball and running with it across the goal line(1). Over the next 30 years, rugby evolved into a separate game played mainly by the upper middle class. Rugby came to North America in 1874 (following soccer in 1869) and gradually evolved into North American football(1).

As rugby is not considered one of Canada's traditional sports, many players enter the sport as an adult, bringing with them habits from other contact sports that are not appropriate in rugby due to its lack of protective equipment. In rugby, players are not allowed to wear any hard protective equipment. Normally, none is worn, but an injured player is allowed to wear soft protection that will not harm other players in any way. This law (rule) excludes most of the protective equipment on the market, especially knee braces with any rigid support (plastic or metal).

Rugby is seeing an increase in popularity lately, as increased costs of outfitting school teams for football is

causing many schools to drop this sport and begin soccer or rugby programs in its place. This popularity has increased in Edmonton in the past few years and rugby is becoming a popular school team sport. Therefore, it is important to establish a baseline of the nature and incidence of the injuries occurring in Edmonton to identify trends and develop coaching techniques or other means to diminish these trends of injuries. To date, there have been no published prospective studies on rugby injuries in Canada.

The game played on the Canadian Prairies is particularly influenced by the environment as the ground is usually hard and dry during most of the season (May to October). Most other countries, as well as the Canadian provinces of British Columbia and Ontario, play rugby under conditions of wet, soft or muddy fields in cool or warm temperatures, and it is under these conditions that most epidemiological studies have been done.

**B) THE PURPOSES OF THIS STUDY**

1) To establish a baseline of data on player profiles, incidence of injuries in Canadian Prairie (Alberta) rugby including nature, location, severity (time lost), and cause of injuries, which occur in a regular season of first division club play, and senior representative level of rugby union games in Edmonton.

2) To determine whether the injured players differ from

the non-injured players in age, height, weight, skill level, position played, use of mouthguards, or preseason training.

3) To describe the occurrence of injuries according to the month of play, time in game, phase of play, ball possession, position played, change of position played, or players playing with previous or simultaneous injuries.

4) To determine risk factors such as various field and weather conditions.

## C) THE RELEVANCE OF THIS STUDY

Canadian rugby is a growing sport and there is a need to establish data on factors affecting injuries so they may be minimized.

Data on trends in injury related to factors described above will help the Canadian Rugby Union recommend changes to the rules to increase the safety of the game.

Ascertaining risk factors, such as mouthguard use, improper tackling techniques, and rucks and mauls, will enable coaches and referees to focus on specific areas requiring changes to decrease injury occurrence.

As unions (rugby organizations) are becoming more organized and structured, they are building and maintaining their own playing fields. There are some aspects of field design and maintenance that are costly but may be important in the prevention of injuries.

The information to be generated by this study will

hopefully put these costs into perspective with player injury and lost playing time to evaluate their importance and will hopefully encourage the unions to invest in the upgrading of their playing fields.

The final report could be used as an educational tool to guide rugby coaches and field maintenance managers in future decision making and work planning to reduce preventable injuries in rugby.

**D) DELIMITATIONS**

i) This study took place over the 1989 Edmonton Rugby season which was of 21 weeks duration from May to October.

ii) The sample included the first division (highest level of club play) from five of the eight clubs in the Edmonton Rugby Union, as well as the senior representative side (team).

iii) The dependent variables measured included the frequency and nature of injuries occurring during rugby games during one season, including nature of injury, time of injury, cause of injury, location of injury, and time lost from play due to injury.

iv) The independent variables of the players age, height, weight, use of mouthguard, preseason training, skill level, player position, previous injury, and ground conditions were monitored by collecting this information on questionnaires.

## E) LIMITATIONS OF THIS STUDY

The limitations of this study were:

1) All of the results could not be generalized to the entire rugby population of Canada, due to different climactic conditions. Other factors which precluded generalization were the skill and training of the players, as in Canadian provinces such as British Columbia, rugby has been played for a longer period of time, and the season is longer, giving the players a better skill basis.

2) Some injuries may have initially been missed if unseen and unreported to the therapist affecting incidence count, although the investigator questioned all players at the end of the season for injuries.

3) Any players who discontinued play were followed up through the club, and telephone interview by the investigator to determine the reason for their absence, thus loss of subjects was kept to a minimum.

4) Some of the responses on the questionnaire were subjective, which may have allowed for individual interpretation by the raters. The subjectivity was minimized by having the specific definitions for each category to be rated given in the guide book, the training of the raters, and the objective checklist format of the questionnaire. The more subjective categories (such as, whether the field condition affected the injury) were not included in the statistical analysis of the data of rates and frequencies, but were

considered when determining patterns of injury.

5) Injuries studied were limited to only those happening during games and meeting the stated definition of injury.

**F) DEFINITIONS OF TERMS**

**i) Reportable injury:** for this study, a reportable injury was defined as any injury arising during and as a result of playing in a rugby match severe enough to cause at least a temporary interruption of a player's contribution to a game (while his team continued to play), or impairing his subsequent ability to train or play (2-5), or requiring medical intervention of any type (3,5-8).

**ii) Nature of injury:** the actual type of injury which occurred to the player (for example: sprain, strain).

**iii) Cause of injury:** the description of the forces involved in causing the injury. The specific mechanisms are listed in the questionnaire (Appendix A).

**iv) Phase of play:** the action of play that the player was involved in at the time of the injury.

**Scrummage**: when, generally, eight players from each team physically bound onto a teammate, with the three front row players engaging their opposite numbers in readiness to allow the ball to be put on the ground between them. The object being to "hook" the ball through the scrummage in order for the scrumhalf to initiate play.

**Maul**: when, during open play, players of both teams are

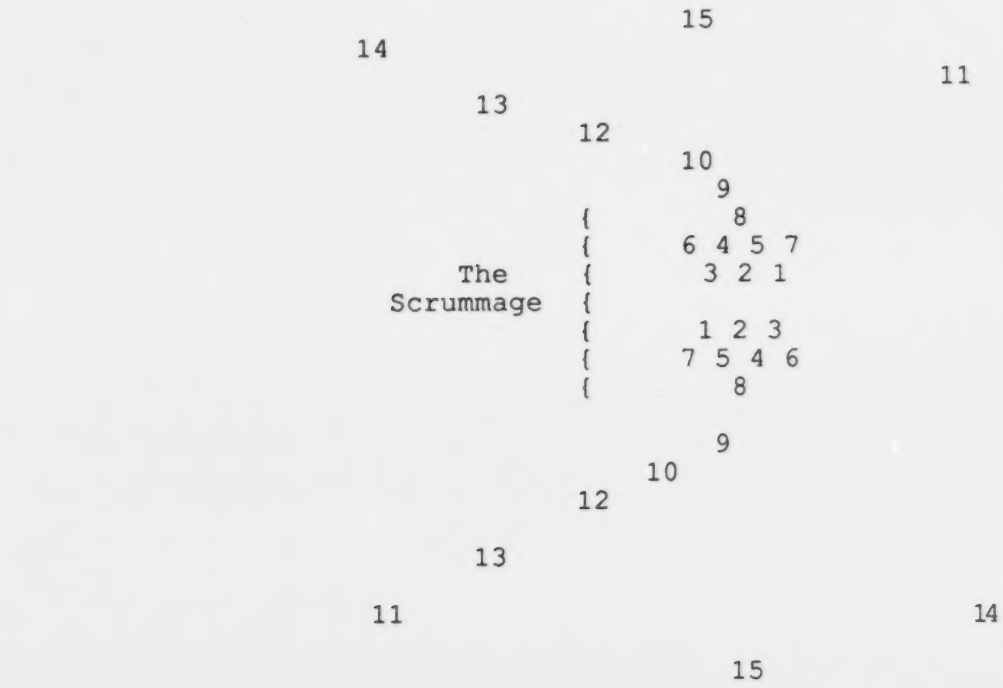
on their feet, bind together and engage one another around a player who is carrying the ball. The object is to move the ball back through the formation for the scrumhalf who initiates a passing movement.

**Ruck**: when, during open play, players of both teams are on their feet, bind together and engage one another around the ball which on the ground, closing the ball between them. The object is the same as for a maul.

**Line-out**: when, after the ball has gone into touch (out of bounds), the forwards of both teams line up in single lines parallel to each other and perpendicular to the sideline, an arm's length apart, facing the sideline, in readiness for the ball to be thrown in between them by the hooker.

**v) Duration:** the duration of play in a match is generally eighty minutes. Play is divided into two halves. At half-time, the teams change ends and there is an interval of not more than five minutes. Much of the literature reports injuries by the quarter of the game. As some reporting therapists did not differentiate more specifically, data will be displayed as to the quarter and half of the game in which the injury occurred.

**vi) Player position:**




Position of players on the pitch at the commencement of a set scrummage.

| FORWARDS: | BACKS: |
|---|---|
| 1: Loose head prop forward | 9: Scrumhalf |
| 2: Hooker | 10: Outside half (Fly half) |
| 3: Tight head prop forward | 11: Winger |
| 4: Second row (Lock) | 12: Inside centre |
| 5: Second row (Lock) | 13: Outside centre |
| 6: Wing forward (Flanker) | 14: Winger |
| 7: Wing forward (Flanker) | 15: Full back |
| 8: Number eight | |

## II. LITERATURE REVIEW

Studies on rugby reported in the literature have reported descriptive statistics on incidence, cause, nature and location of injury. They have looked at the effects of game factors such as time in season and time in game of the injuries, as well as assessing risk factors such as phase of play, player position and skill level. Some studies have also reported on the influence of playing surfaces on injuries.

### DATA COLLECTION

Of the studies cited in this paper, most had unstratified samples, collecting data at tournaments or medical facilities to include all levels of player skill and age. Two studies (2,9) followed one club or school, and four studies (3,8,10,11) followed a league or one division (level of play) of clubs.

Much of the literature cited results based on data which had been collected at a doctors office or medical facility (1,8,9,12-15), therefore, only included those players who required expert medical attention. Other studies included all injuries (per their definition of injury) and data were collected from the teams directly by the researchers. However, much of the data collected from teams were by questionnaires filled out by players or other team members rather than by trained raters(3,11,16-18) or used old records in retrospective studies(14,15). Only three studies stated that they interviewed or examined the players themselves(2,10,19).

Thus, most of the literature is based on general data, not collected in a particularly reliable manner, with questionable validity of their results regarding accuracy and ability to generalize to other populations.

## 1) INJURY FACTORS

### A) INCIDENCE OF INJURIES IN RUGBY

Most literature on rugby injuries has been descriptive studies of incidence of injuries in Great Britain(5,6,11,13, 14,19-26), Ireland(2,7), South Africa(3,8,10,16,17,27,28), Australia(9,18,29), and New Zealand(12,30). One study, Micheli and Risebrough(1), was done in the United States, but there are no published prospective studies based on Canadian statistics to date.

Studies present in the literature analyze injuries on a basis of injuries per player hour(1,9,17,26), per game(1,2,9, 10,16,18,19,30,31) or per practice(16,30), or per year(3,11, 14,25,29).

Micheli and Risebrough(1) studied rugby injury statistics from three Northeastern United States colleges to find an overall injury rate of 9.8%.

Addley and Farren(2) did a comprehensive study on injuries sustained in one season of an Irish Rugby Club (adult). They studied the variables of age, time of injury, phase of play, player position and nature of injury to determine incidence of injury. Their results showed that

overall incidence of injury was one per 14 player appearances.

Reilly and Hardiker(19) found an overall injury rate of nine per game, and 1.7 serious injuries (those injuries where full training could not be attempted two days after injury) per game in 18-22 year olds.

Clark, Roux and Noakes(3) did a prospective study of 8 adult rugby teams over a season to record a total of 114 injuries sustained by 78 players. They found that incidence of injury was greater for adult players than juniors for games, but much less for practices.

Myers(9) did a prospective study of injuries occurring in adult rugby games at one location to find a rate of injury of 0.032 injuries per player-hour (or 1.23 injuries per game, or 0.041 injuries per player appearance).

Walkden(14) analyzed injuries occurring at one rugby ground over 10 seasons retrospectively to find an average of 100 injuries per season for thirty matches and 1000 player appearances per season.

Badley(31) did a cross-sectional study of 111 junior and senior teams over a one week study period. The study participants were involved in 224 practices as well as 135 games to receive 100 injuries, with an individual player sustaining an injury in every 21.3 games.

Davies and Gibson(11) did a prospective study of 10 rugby clubs (185 players) over one season to record 151 injuries.

Nathan, Goedeke and Noakes(16) studied a school team in

South Africa for one season to find an overall incidence of injuries during matches to be one per 119 boy hours of match play.

Sugarman(18) studied injuries in schoolboy rugby in Australia to find an overall injury rate of 0.98% per player per game.

Roux(17) studied schoolboy rugby and found that the overall injury rate during matches was one per 142 boy hours of play, compared to one per 1825 boy hours of practice.

Sparks(26) analyzed records of rugby injuries occurring over 30 seasons at one school to find an incidence of 197.7 injuries per 10,000 player hours.

Thus, rate of injury ranged greatly between studies, as did the authors method of reporting this information.

Other studies focused on the use of mouthguards and orofacial injuries(10,29,30) or spinal injuries(25) and will be discussed in a later section of this paper.

**B) CAUSE OF INJURY**

All authors agreed that rugby was a sport with a high incidence of injury, and that these injuries predominantly arose from physical contact with other players, the playing field, goal posts and the ball(1-3,5-14,16-26,29-33).

The latter three categories can be termed boundary conditions (versus dynamic factors) as described in a study on the influence of playing surfaces to injuries by Nigg and

Segesser(33), and are more easily changed than the dynamic factors. These factors will be discussed further in a later section of this paper.

**C) NATURE OF INJURIES**

Micheli and Risebrough(1) found that sprains (20%), fractures (20%), contusions (16%), strains (13%), and acromio-clavicular joint separations (13%) were the most common injuries. Addley and Farren(2) found that the most common injuries were strains (28%), sprains (23.5%), and contusions (23.5%). Clark and Roux(3) also found that strains (33%) and sprains (32%) were the most common injuries, followed by fractures (11%) and concussion (10%).

The types of injuries most often recorded in Nathan, Goedeke and Noakes'(16) study were muscle injuries (21.5%), concussions (21%), ligament injuries (17.7%), and fractures (15.2%). These injury frequencies related to other studies with the exception of the increase in concussion occurrence.

Sugarman(18) found that sprains (25%) were the most common injury, followed by fractures (20%), strains (16%), and bruising (15%), similar to Nathan et al(16). The general trends of injuries in the study by Roux(17) were similar to other schoolboy studies. These data are displayed in Table I.

**D) LOCATION OF INJURIES**

Micheli and Risebrough(1) found that injuries most often

**Table I: NATURE OF INJURIES FOUND BY VARIOUS EPIDEMIOLOGICAL STUDIES**

| INJURY | MICHELI (1)+ | ADDLEY (2)+ | SUGARMAN* (18)+ | NATHAN* (16)+ | ROUX (17)+ |
|---|---|---|---|---|---|
| CONCUSSION | NR | 4.0% | 8.0% | 21.5% | 12.0% |
| MUSCLE (STRAIN) | 13% | 28.0% | 16.0% | 26.6% | 17.0% |
| LIGAMENT (STRAIN) | 20% | 23.5% | 25.0% | 17.7% | 25.0% |
| FRACTURE | 20% | 4.0% | 20.0% | 15.2% | 27.0% |
| DISLOCATION | 5% | 4.0% | 5.0% | 5.1% | 10.0% |
| BRUISING | 16% | 23.5% | 15.0% | 7.6% | 6.0% |
| LACERATION | 8% | 13.0% | 9.0% | 5.1% | NR |
| ACROMIOCLAVICULAR JOINT SEPARATION | 13% | NR | NR | NR | NR |
| OTHER** | 5% | NR | 1.0% | NR | NR |
| EAR | NR | NR | NR | 1.3% | NR |
| INTERNAL INJURIES | NR | NR | NR | NR | 3.0% |

* : Any total not equal to 100% is due to 'rounding' of figures
**: 'Other' category was not specified by the authors.
NR: Not Reported
+ : reference number

were to the shoulder (32%), head and neck (13%), and knee (13%). Location of injuries are listed in Table II. In a comparison to football injuries, they noted that there were fewer knee injuries in rugby, possibly due to the lack of crossbody blocking in rugby. Over half of football knee injuries were caused by this action.

Addley and Farren(2) found that the injuries were to the leg (36%), arm (27%), head (16%) and trunk (14%). Clark and

Roux(3) agreed with these findings with injuries to the lower limb (44%), upper limb (27%) and head and neck (23%) most frequent.

Davies and Gibson(11) found that injuries to the knee were the most common, followed by the head and shoulder. Sugarman(18) found that knees (12%) and ankles (11.9%) were the most frequently injured area, followed by the skull (8.3%), shoulder (6.7%), and finger (5.6%).

Roy(8) studied incidence of injuries in adult rugby players, but collected data from injured players seeking medical attention at a medical facility after a match, rather than following a specific team or league. He found that the head and face received the greatest numbers of injuries (20.5%), followed by the knee (14.5%) and ankle (13.5%). Perhaps the higher percentage of head and face injuries, relative to other data, was due to the higher necessity of the injuries requiring medical attention (ie. suturing lacerations).

**E) CERVICAL SPINE INJURIES**

Most studies of risk factors in rugby, have focused on the risk of spinal cord injuries(7,15,18,22,24,25,28,32,34-38). Although rare, spinal cord injuries are important, as they are one of the most catastrophic permanent injuries that occurs with rugby. Some implicating factors in spinal cord injury have now been identified, such as axial loading of the

**Table II: LOCATION OF INJURIES FOUND BY VARIOUS STUDIES**

| LOCATION | ADDLEY (1)+ | MICHELI (2)+ | ROY (8)+ | NATHAN (17)+ | SUGARMAN (16)+ | ROUX (18)+ | SPARKS (26)+ |
|---|---|---|---|---|---|---|---|
| HEAD | 16% | 21.5% | 20.5% | 25.3% | 20.7% | 29%* | 16.9%* |
| ARM | 27% | 31.2% | 10.0% | 29.1% | 28.4% | 20% | 25.9% |
| TRUNK | 14% | 11.2% | 3.5% | 7.6% | 9.3% | 13% | 11.1% |
| NECK | 7% | 2.3% | NR | 12.7% | 4.6% | NR | NR |
| LEG | 36% | 33.3% | 35.5% | 25.3% | 37.0% | 37% | 46.1% |

* : combined results for head and neck injuries
NR: not reported
+ : reference number

spine in flexion during improper tackling and scrummaging, and recommendations have been made on how to decrease the risk of this injury.

Recommendations include player selection factors for position played, matching players in terms of strength and skill, providing training for specific positions and tackling, strengthening of the cervical muscles, changing player attitudes, changing rules to prohibit unsafe play, enforcing these rules to a greater extent, and making the scrummages safer (pinpointed as a major source of preventable injuries).

Many of the rugby unions immediately adopted the rule changes that have been recommended since 1980. Studies now show a decline in cervical spine injuries occurring in the components of the game affected by the altered rules, although magnitude of change varies with authors(13,22,24,25,31,34).

One major recommendation from all authors, is continued

work by medical advisory committees and rugby unions in recognising, preventing, and managing serious injuries in rugby(1,2,6,8,10-12,14,16,17,29,31).

Another recommendation by Scher(36,37), was for routine x-ray examination of the cervical spine for all players prior to playing rugby, and thorough examination of any player with cervical spine symptoms. In the new player, this procedure is to rule out congenital fusions of the vertebrae which will make the player more susceptible to trauma of the spine(37). In the older player, this procedure will detect vertebral fusions, narrowing of the spinal canal, spondylosis or evidence of previous vertebral fracture (36). Older rugby players appear to have early degenerative changes of the cervical spine which leave the spinal cord vulnerable to damage after hyperextension injuries as well(36).

## 2) GAME FACTORS

### A) INJURIES BY MONTH OF PLAY IN SEASON

Nathan, Goedeke and Noakes(9) found that there was a higher incidence of injuries occurring in the early season (April) and midseason (July). Sugarman(18) found that injuries peaked in midseason (June), but the number of injuries per game remained relatively stable throughout the season, which was similar to the findings of Roy(8). Clark and Roux(3) found adult injuries were highest in early season (April to May), then peaked again in late season (August)

after a break in the league schedule. Roux(17) found that injuries peaked during early season and midseason (after winter break) as for other schoolboy studies.

**B) INJURIES BY TIME IN GAME**

Addley and Farren(2) found that the second and fourth quarters were the time of greatest risk, and most injuries were soft tissue injuries.

Davies and Gibson(11) found the time of highest injury was in the last quarters of the game (specific quarters not specified by authors). Roy(8) found a slightly higher rate of injury in the third quarter of the game.

**3) RISK FACTORS**

There is a great concern by many of the rugby unions, and the International Rugby Football Board on the incidence of serious injuries. They are now working to determine the causes of injuries and are attempting to make the game safer by altering the identified causative factors.

Risk factors studied include phase of play, player position, level of skill of players, use of mouthguards, and playing surface condition.

**B) PHASE OF PLAY**

Addley and Farren(2) found that the injuries occurring during player to player contact were 18% while being tackled,

16% while tackling, and 13% during a ruck/maul. Table III illustrates the breakdown of phase of play for injury occurrence.

Davies and Gibson(11) found that knee injuries occurred during running and dynamic play, but head and neck injuries were more common during static play (scrummages, mauls).

Roy(8) determined that player to player contact caused most injuries, with a high percentage due to foul play.

Injuries related to phase of play found by Nathan et al(16) differed from adult statistics with a low incidence of injury due to foul play, and a higher incidence of scrummage injuries.

Clark and Roux(3) also found the injuries highest from being tackled (26%), followed by open play (21%), rucks and mauls (17%), and tackling (14%).

Sugarman(18) found that schoolboy injuries arose from player to player contact, predominantly from tackles (46.7%), followed by rucks (15.6%), running (8.4%), mauls (7.5%) and scrummages (6.6%) which was consistent with other studies.

Roux(17) also found that tackles (55%) were the most common cause of injury, followed by scrummages/rucks/mauls (26%).

**C) POSITION PLAYED**

Addley and Farren(2) determined that the incidence of injuries were greater to forwards (60.0%) than to backs

**Table III: PHASE OF PLAY/PERCENTAGE OF INJURY OCCURRENCE FOUND BY VARIOUS STUDIES**

| PHASE | ADDLEY (2)+ | CLARK (3)+ | NATHAN (16)+ | SUGARMAN (18)+ | ROUX (17)+ |
|---|---|---|---|---|---|
| BEING TACKLED | 18.0% | 26.0% | 25.0% | 28.1% | 30.0% |
| TACKLING | 16.0% | 14.0% | 22.0% | 18.6% | 25.0% |
| RUCK/MAUL | 13.0% | 17.0% | NR | 23.1% | 18.0% |
| RUNNING | 13.0% | NR | 11.0% | 8.4% | 8.0% |
| PILE-UP | 12.0% | NR | NR | 3.1% | NR |
| GATHERING | 10.0% | NR | NR | NR | NR |
| OPEN PLAY | NR | 21.0% | NR | NR | NR |
| SCRUM | 8.0% | 9.0% | 24.0% | 6.6% | 8.0% |
| COLLISION | 6.0% | NR | NR | NR | NR |
| LINE-OUT | 1.0% | 3.0% | 4.0% | 1.6% | 1.0% |
| OTHER* | 1.0% | 10.0% | NR | 10.2% | 11.0% |

* : includes foul play and categories not specified by authors
NR: not reported
\+ : reference number

(39.5%). Their highest rate of injuries were to positions of loose head prop (13%) and open side wing forward (14%). The authors felt that a weakness of their study related to the voluntary reporting of injuries by the player, but as they did interview the players themselves immediately following a match, most major injuries would be noted. Their study correlated to studies of Scottish rugby but not to English rugby in mechanism of injury and player at risk. This demonstrates the importance of separate evaluation of injuries

sustained in different countries, as the style of rugby played differs in each country and data of incidence of injury cannot be directly applied to every country.

Davies and Gibson(11) agreed that forwards had a higher incidence of injury than did backs, and the players with several injuries were heavier than uninjured players.

Unlike other studies, Roy(8) found a fairly constant rate of injury related to player position, with forwards (56%) higher than backs (45.5%) in total injuries.

Clark and Roux(3) found that the most commonly injured players were the hookers (19%), followed by the wings (15%), and the fullbacks (11%). Their overall results showed injuries split evenly between the forwards and backs.

Nathan et al (16) determined that the schoolboy positions receiving the most injuries were the hooker (31.6%), fullback (14.7%), number 8 (12.6%), scrumhalf (10.5%), and outside half (8.4%). These statistics showed that injuries were not consistent with incidence of injuries in adult statistics as only the hooker and number 8 are forwards in the above group.

Sugarman(18) found that the positions of play with the highest incidence of injury included the hooker, props, outside half and left wing. As with Nathan et al(16), the injuries were not predominantly with the forwards. He also related type of injury to player position to determine that forwards had more shoulder injuries than backs, and backs had more knee and ankle injuries mainly resulting from being

tackled.

Scher(27) studied degenerative changes in the cervical spine of rugby players and found that front row players and locks had a high incidence of degenerative changes compared to loose forwards and backs.

Data for injury occurrence by player position is displayed in Table IV.

**Table IV: INJURY OCCURRENCE BY PLAYER POSITION FOR VARIOUS STUDIES**

| POSITION | ADDLEY (2)+ | ROY** (8)+ | MYERS (9)+ | NATHAN (16)+ | SUGARMAN (18)+ | REILLY (19)+ |
|---|---|---|---|---|---|---|
| HOOKER | 7.0% | 11.0% | 5.9% | 31.6% | 7.8% | 10.1% |
| PROP FORWARD* | 16.5% | 9.0% | 10.7% | 2.1% | 14.5% | 12.0% |
| SECOND ROW* | 12.0% | 11.0% | 12.9% | 4.2% | 9.9% | 6.9% |
| WING FORWARD* | 19.0% | 11.0% | 15.9% | 5.8% | 13.4% | 13.3% |
| NUMBER 8 | 6.0% | 14.0% | 4.1% | 12.6% | 6.8% | 7.1% |
| SCRUM HALF | 3.5% | 7.0% | 6.6% | 10.5% | 7.3% | 10.9% |
| OUTSIDE HALF | 7.0% | 8.5% | 3.0% | 8.4% | 4.5% | 10.1% |
| CENTRE* | 10.0% | 9.0% | 10.7% | 5.3% | 14.1% | 8.4% |
| WING* | 12.0% | 10.5% | 11.4% | 4.7% | 14.6% | 6.9% |
| FULL BACK | 7.0% | 9.5% | 8.5% | 14.7% | 7.0% | 14.3% |
| POSITION NR | 0% | 0% | 10.3% | 0% | 0% | 0% |

*: Positions which have two players
**: Any total not equal to 100% is due to 'rounding off' of numbers by authors.
NR: Not Recorded
+ : reference number

Roux(17) also found that schoolboy injuries were evenly distributed among forwards and backs, with the number 8 (13%), outside half (12%) and winger (12%) being most at risk.

Reilly et al(19) also found that forwards were injured more frequently, but that backs suffered more serious injuries, with the fullback (14.3%) most at risk. They suggested that this frequency was due to the higher velocity of impact of tackles received by the backs.

**D) SKILL LEVEL / AGE**

In Davies and Gibson's(11) study of adult British rugby clubs, it was found that first division players had a slightly higher incidence of injury than second or third grade players.

Nathan, Goedeke and Noakes(16) found that the greatest incidence of injury was in the Under 19 age group, and with the higher skill level of players.

Sugarman(18), Clark and Roux(3), and Roy(8) also found a higher rate of injury with the higher level of skill of the players consistent with the literature.

**E) USE OF MOUTHGUARDS**

It is a commonly held belief that mouthguards help to prevent orofacial injuries as well and concussion in contact sports. Several studies reviewed(29,39-42) did retrospective studies via questionnaires filled out by players. These studies showed significant reduction in these types of

injuries by wearers of mouthguards versus nonwearers on the same team. These studies also showed that many players did not like wearing the mouthguards due to discomfort, difficulty in breathing and talking. The rates of wearers ranged from 25% to 96%(29,40)

Blignault, Carstens and Lombard(10) did a prospective study of University first team players over 555 player occasions (each time one player plays in a match is one player occasion). The researchers interviewed each player before and after each match to collect the data. Results were analyzed by Chi Square test to find that there were no significant differences between injuries sustained by wearers and non-wearers of mouthguards during rugby matches. They concluded that mouthguards did not prevent oral and dental injuries, and were not cost effective.

**4) INFLUENCE OF PLAYING SURFACES ON INJURIES**

The influence of playing surfaces on injuries is another area of preventable injuries that has been recognized by previous authors but has not been studied closely. Roy(8) and O'Connell(7) mentioned the influence of uneven surfaces on injuries in their studies. Roy(8), Inglis and Stewart(12) related percentage of injuries to wet versus dry weather. Of the studies reviewed, only Davies and Gibson(11), and Inglis and Stewart(12) made an attempt to relate injuries specifically to pitch (field) conditions, and they looked only

at hard versus soft fields.

Davies and Gibson(11) found that head and neck injuries were more common on wet surfaces and shoulder injuries were the only type which seem to increase on hard surfaces.

Roy(8) did not find that injury rate related to various positions differed under disparate weather conditions, but types of injuries did (only 13% of knee injuries but 33% of ankle injuries occurred in wet weather).

Nigg and Segesser(33) found that there was a relationship between frequency and type of injury and playing surface when they surveyed football injuries on natural versus artificial turf in North America.

Although rugby is played on natural fields, the conditions of these grounds change in similar variables to those between artificial and natural turf (for example, compliance, frictional resistance against rotation and translation forces). The nature of the game (tackling) of football is similar to rugby so the relationship of injuries to playing surface should be similar, but magnified with rugby due to the lack of protective equipment worn in rugby. Nigg and Segesser(33) also theorized that these changes might alter the movement of athletes and therefore change the forces acting on the players locomotor system. However, they found no reports evaluating this theory or relating to the cushioning properties of surfaces.

## 5) SUMMARY

The literature reviewed had a wide range of incidence of injury and reporting methods, but all authors agreed that rugby has a high incidence of injury. Injuries predominantly arose from contact with other players and boundary conditions in the reviewed studies. Sprains and strains were found to be the most common type of injury. The leg, shoulder and head were found to be the most common locations of injury. Cervical spine injuries were given special consideration as a high risk injury. The authors reviewed found peaks of injury in early or midseason, and in the second or third or fourth quarters of the game. Tackles, scrummages and rucks/mauls were the highest risk phases of play. Some authors found that forwards had a higher incidence of injury than backs, while others found injuries fairly evenly divided between forwards and backs. The authors found that rate of injury was higher with higher levels of skill. Mouthguards were not shown to be helpful in preventing orofacial injuries. Uneven, hard and wet surfaces show different trends in injury occurrence.

Incidence of rugby injuries has received international attention but there are no Canadian statistics in this area. The International Rugby Board is concerned about the safety of rugby and has made changes in the rules to eliminate preventable causative factors. Further research is needed to identify other preventable causative factors in rugby injuries to pursue the goal of increasing the safety of rugby.

## III. METHODS AND PROCEDURES

### 1) POPULATION AND SAMPLE

The sample was drawn from the Edmonton Rugby Union, the organization to which all rugby players in Edmonton belong (700 playing members), and which scheduled all games, tabulated results, and enforced the rules to be followed in the game.

The stratified sample studied was the first division players (highest level of competition for club players) of six men's rugby clubs (those that participated), and the men's senior representative team (consisting of the top players from all of the clubs, who play other representative teams from other locales). (see Appendix B: Letters of Support).

This sample was representative of the population of rugby players who played under similar climatic conditions on the Canadian prairies, as the same categories for play (age groups and skill level) are used across the country. Thus, this study will be generalizable to all rugby players playing in the same climactic conditions in Canada as the sample group.

All player injuries that fit the given definition of injury in a game were recorded and number of players in that game were noted (ie. 15 players per game plus replacements) to determine incidence and rates of injury (see Appendix C for formulae). Specific definitions of injuries and criteria for the questionnaire are included in the "Guidelines to completion of Edmonton Rugby Injuries Questionnaire" (see

Appendix D).

This sample size for this study was 172 players and 114 injuries were reported.

The stratification of the sample groups allowed data to be collected from all players of the same relative skill level and motivational level to play. Motivation is important for data pertaining to time lost from play as the higher level of player is likely return to play as soon as possible rather than stay away for time greater than required due to the injury, or be lost to follow up. Some of the studies reviewed (3,9,11,16,17,18) showed that most of the injuries occurred with players of higher skill and fitness levels.

The raters were the trained team physiotherapists (one rater per team) who were working with the rugby clubs which agreed to participate in the study. All therapists had at least one prior year of experience in recognizing and monitoring injuries while working with teams. Those teams without team therapists were not included in the study due to the inability to accurately record injuries. All teams had assessment of injury reviewed by a follow-up telephone interview by the researcher. As most of the data of previous studies had been collected by team members or coaches without accurate assessment of the injuries, and as accurate assessment affected only one section of the data being gathered, this data collection method should not have affected the comparability of the data collected to the present

literature.

## 2) STUDY DESIGN

The study was a prospective study. Part of the study was descriptive in establishing the norms for incidence of injuries, with the variables affecting injury being recorded. This method is the standard procedure to develop a baseline of data for future studies in Canada, where there has been no previous data collection.

Part of the study was designed to determine risk factors for rugby in Alberta to help ascertain which areas of rugby need to be altered to increase the safety of playing the game.

## 3) DATA AND INSTRUMENTATION METHOD

Initially, a letter (Appendix E) was sent to each club in the Edmonton Rugby Union and the Edmonton Rugby Union executive outlining the study and requesting the club's and the Union's participation and signing of consent forms (Appendix F). As the rugby community in general is concerned with making rugby a safer sport, there were no refusals from the teams.

The therapist of each team was given questionnaires to be filled out on each injury (a sample of questionnaire is in Appendix A) for the duration of the 1989 rugby season. One of the raters used the proposed questionnaire in a pilot study during a rugby tournament to assess feasibility of the

questionnaire in the preceding month of March.

The injured player's name, age, height, weight and playing position were indicated on the questionnaire. It was indicated if the player was playing in a position that was not his regular position.

Presence of a mouthguard, and type and duration of preseason training was noted.

The nature of the injury was noted as one of the following: sprain, strain, bruise, fracture, dislocation, subluxation, concussion, spinal injury, laceration/abrasion, or other. Definitions of these terms were listed in the guide book that each rater had, for consistency of terminology (Appendix D).

The location of injury was indicated by checking off which part of the body was injured from the list in section 3 of the questionnaire.

The mechanism of injury was determined by the rater and player during an interview, and categorized as: a direct blow, twisting or rotation force, compression force, overstretching, overstraining, tripping or falling, landing or other.

It was noted if the ball was involved in the play (to rule out foul play), whether this injury was a reinjury (same injury as previously received) or whether the player was suffering from another injury at the time of this injury.

The phase of play in which the player was involved at the time of injury was indicated as: scrummage, ruck/maul,

line-out, tackling, being tackled, running, or collision.

The time of injury in the season was noted by the date, and the time of injury in the game was noted by which quarter of the game in which the injury occurred. One rater indicated which half of the game, instead of quarters, so data categories were modified to account for this.

Time lost from play was listed as: none, returned to same game, did not complete game, and number of weeks lost from practice and/or games.

The location of the game was noted as to which fields were involved.

The field condition at the site of injury was noted by checking off descriptive terms. In analysis, these terms were grouped together to form the most common categories of field conditions (ie. hard and dry or wet and soft). The rater's opinion of how the field condition affected the injury was noted as caused, increased, decreased, or not sure.

## VALIDITY

The most significant type of internal validity for this study was content validity of the questionnaire. Previous studies have categorized injuries into area of the body injured, type of injury, time of injury in game and in season, mechanism of injury and related these factors to position played to establish rates of injury.

The questionnaire developed for this study incorporated

all of the variables monitored by the previous authors and added the independent variable of playing field condition. The questionnaire was reviewed by the physiotherapists who were the raters for the study, to include their input on terminology used, factors being monitored, and ease of use of the questionnaire.

The questionnaire was also presented to experts in the area of rugby as well as experts in the area of research in incidence of sports injuries, for their evaluation to assure content validity.

**RELIABILITY**

Reliability was not analyzed statistically, however it was monitored via the following means. The therapists were carefully instructed on the use of the questionnaire, and definition of terms of reference were clarified at training sessions. A printed guide to completion of the questionnaire was given to each rater outlining the specific criteria for evaluation of the data being collected, for their future reference (Appendix D).

There were trial runs of completion of the forms at preseason games, with the researcher reviewing forms individually with each rater. After these practice runs, the raters reached a level of skill in recording data that should not have changed during the season but further monitoring of the raters while completing the questionnaires was done by the

researcher during the season to ensure accurate recording of data. The researcher also conducted telephone interviews with all of the players included in the study to clarify data collected and correct any mistakes.

The data should accurately reflect the frequency of injuries. This type of information is routinely collected for each team, at a less specific level, and the players are co-operative in reporting their injuries.

The questionnaires were a checklist type to simplify the work of the raters and aid in consistency and objectivity of responses.

These measures ensured reliable data, or recognition of problems to allow for subsequent correction of the data.

**TIME SCHEDULE**

The teams were approached for their consent to participate in the study in April 1989. The Edmonton Rugby Union (ERU) submitted written support on behalf of the league. The teams were contacted in April for verbal consent as written consent had not yet been received.

The physiotherapists were involved in reviewing the questionnaire as it was developed. Experts were approached to review the questionnaire content in March and April of 1989. The proposal was presented for ethics review in May of 1989. There were instruction sessions in the use of the questionnaire in early May (prior to the start of the season),

with practice in rating games at trial games in May. Study data were collected during league play from May to October 1989.

**4) ANALYSIS OF THE DATA**

Descriptive statistics were used in evaluating the frequency of the injuries, with results expressed as percentages of injuries for the independent and dependant variables (proportional rates). To determine the incidence rate, the numerator was the total number of injuries and the denominator the total number of games played. See Appendix C for further examples of the statistical formulae that were be used.

A Chi Square test was used in the analysis of the association between playing field condition, and incidence and severity of injury as a case control study analysing the relative risk of incidence of injury with exposure to these factors(43).

Chi Square tests were also used in the analysis of the association of injured and non-injured players for position played, skill level, preseason training, and use of mouthguards.

T-tests were used in analysing the differences between rates of injury with or without pre-existing injury, and between profiles of injured and non-injured players.

## IV) RESULTS AND DISCUSSION

### 1) BASELINE DATA

#### A) PLAYER PROFILE

The mean *age* for all players, representative players, first division players, forwards and backs are listed in Table V. These ages were slightly higher than the group studied by Jardine(44), who averaged 22.4 years for backs and 23.1 years for forwards, with an average team age of 22.8 years and a standard deviation of 1.9 years.

The mean *height* of all players, representative players, first division players, forwards and backs are listed in Table V. Jardine(44) found a mean height of forwards of 73.82 inches, of backs 71.06 inches and a team mean of 72.48 inches with a standard deviation of 3 inches.

The mean *weight* of all players, representative players, first division players, forwards and backs are listed in Table V. Jardine found a similar trend in weight with the mean weight of forwards 215.6 pounds, of backs 174.0 pounds, and a mean team weight of 195.8 pounds with a standard deviation of 26.2 pounds.

The representative team players played a mean of 13.46 first division *games*, 1.04 games in other divisions, and 4 Edmonton representative team games. The first division players played a mean of 10.67 first division games, 6.61 games in other divisions, and 0.99 Edmonton representative team games.

**TABLE V: PLAYER PROFILES**

| | ALL PLAYERS | FORWARDS | BACKS | REP PLAYERS | FIRST DIVISION |
|---|---|---|---|---|---|
| mean age (years) | 25.82 | 26.36 | 25.47 | 27.1 | 25.38 |
| standard deviation | ±4.59 | ±2.10 | ±1.00 | ±4.61 | ±4.65 |
| mean height (inches) | 71.07 | 71.97 | 69.77 | 71.75 | 70.95 |
| standard deviation | ±2.96 | ±2.10 | ±1.90 | ±2.92 | ±3.13 |
| mean weight (pounds) | 188.58 | 201.44 | 172.40 | 193.71 | 189.45 |
| standard deviation | ±24.53 | ±16.00 | ±9.30 | ±20.90 | ±25.43 |

Of first division players, 60.0% (60 players) [figures in brackets throughout the results section indicate actual numbers recorded] wore a mouthguard to play, while 55.85% (16 players) of representative players wore a mouthguard. Although lower than desired, these figures are similar to those in the literature. Chapman(40) found that 92.8% of the Australian touring team wore mouthguards, but only 25% of the British team did in his 1986 survey of these two teams. In 1987, he(39) found that 50% of the US World Cup team wore them. In his(29) 1984 study, 96.1% of club players, 93.8% of the Queensland team, and 79.2% of the Australian team wore mouthguards. Blignaut et al(10) found 35% of the first division university players in South Africa wore mouthguards.

**B) INCIDENCE**

The incidence of injuries for first division club games was 0.089 (101 injuries for 1140 player appearances), or a rate of 8.856%. The incidence of injuries for senior representative team games was 0.114 (13 injuries for 114 player appearances), or a rate of 11.440%.

These rates are similar to those found by Micheli and Risebrough(1) in the Northeastern United States, Addley and Farren(2) in Ireland, but lower than those found by Reilly and Hardiker(19) in England as previously described. These rates are higher than those found by Nathan, Goedeke and Noakes(16), Roux(17), and Sugarman(18) who looked at younger player populations.

**C) CAUSE OF INJURY**

The most common cause of injury (58 injuries) for all players was a direct blow (51.3%). A direct blow caused 69.2% (9 injuries) of representative players', and 49.0% (49 injuries) of first division players' injuries.

A twisting or rotation force caused 18.6% (21 injuries) of all injuries, 15.4% (2 injuries) of representative player injuries, and 19.0% (19 injuries) of first division injuries. Overstretching was the next highest cause of first division injuries with 11.0% or 11 injuries, and overall 9.7% or 11 injuries, but not a cause of any representative player injury. Representative players were also injured by compression force

(7.7%) and landing (7.7%) with one injury for each.

First division players had a total of at least eight causes of injury, compared to four for representative players. Detailed data are displayed in Figure 1. This finding could be due to the higher skill and fitness level of representative players, as they did not show "self-inflicted" causes of injuries, such as overstretching, overstraining, tripping or falling, as did the first division players. Also, the greater forces going through the scrummages, rucks and mauls, and the greater speed of the representative team play lends itself to the greater incidence of injuries caused by direct blows and rotation forces.

**D) NATURE OF INJURIES**

Sprains were the most common injury (26.5% or 30 injuries) for all players. Contusions comprised 18.6% (21 injuries), lacerations 12.4% (14 injuries), and strains 10.6% (12 injuries) of the most common injuries. Figure 2 depicts these data in detail.

Sprains and lacerations were the highest injury (23.1% or 3 injuries each) for the representative team players. Strains and concussions without loss of consciousness each comprised 15.4% (or 2 injuries) of the injuries, while contusions, dislocations and spine injuries without radicular signs each comprised 7.7% (1 injury) of the rest of the injuries.

First division players had 27.0% (27) sprain injuries,

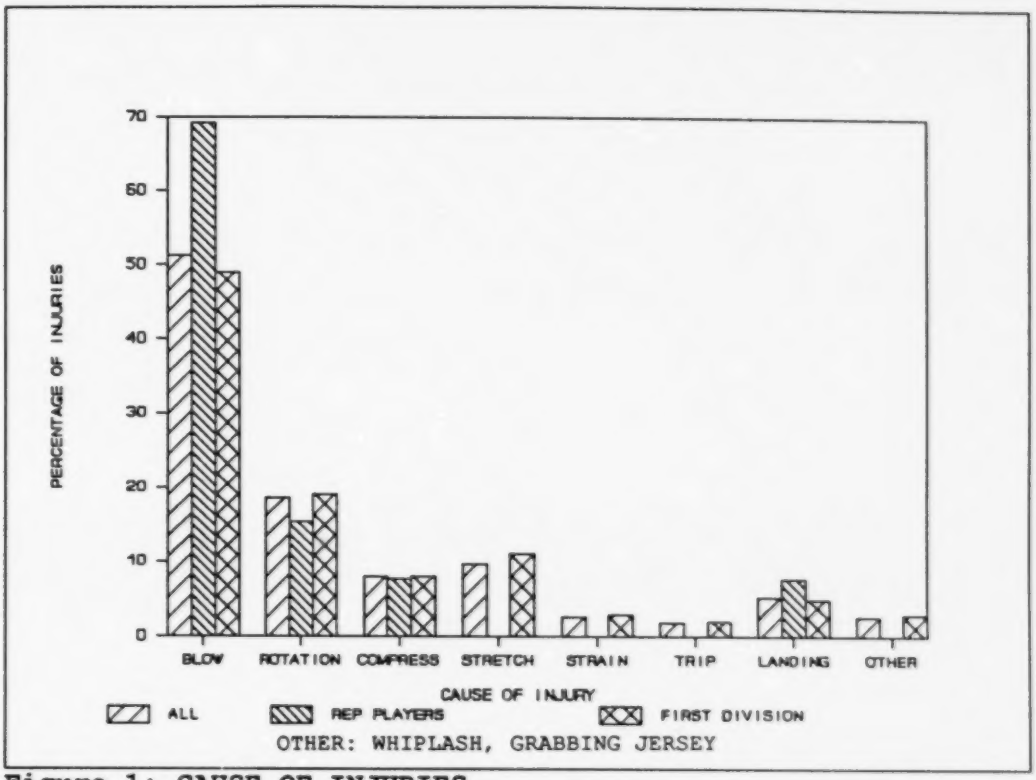



**Figure 1: CAUSE OF INJURIES**

20.0% (20) contusions, 11.0% (11) lacerations, and 10.0% (10) strain injuries. Of note, there were more spine and concussion injuries in this group than the representative players group, both with and without loss of consciousness or radicular signs.

These data generally correlate with the reviewed literature. All authors have noted sprains as a leading type of injury. Strains and contusions are other common types of injury in this study as well as in the literature. Lacerations were found to be a more common injury in this study than in the literature, while fractures were less common

in this study than previously reported.

**E) LOCATION OF INJURY**

The most common general sites of injury were the leg (34.5% or 42 injuries) and head area (25.7% or 29 injuries) in this study for all players. This finding generally agrees with the reviewed literature. However, upper extremity injuries were not as common as indicated by the literature. Figures 3 through 6 display the data of this study in detail. Of note, there were no neck injuries in the representative team player group.

For specific areas, this study found that the head was the most frequently injured area with 11.5% (13 injuries) of all player injuries, followed by the knee and ankle, both with 10.6% (12) of the injuries. These data agree with findings by Sugarman(18) and Roy(8), while Micheli and Risebrough(1), Clark, Roux and Noakes(3), as well as Addley and Farren(2), found a higher incidence of shoulder or arm injuries.

First division players had 12.0% (12 injuries) of their injuries to the ankle, and 11.0% (11) to each of the head and neck, with the rest of the injuries distributed to 24 other areas of the body. Representative team players had 23.1% (3 injuries) of their injuries to the knee, with 15.4% (2 injuries) to each of the head, face and shoulder. The eye, back, thumb and anterior thigh each had 7.7% (1 injury) of the remaining injuries.

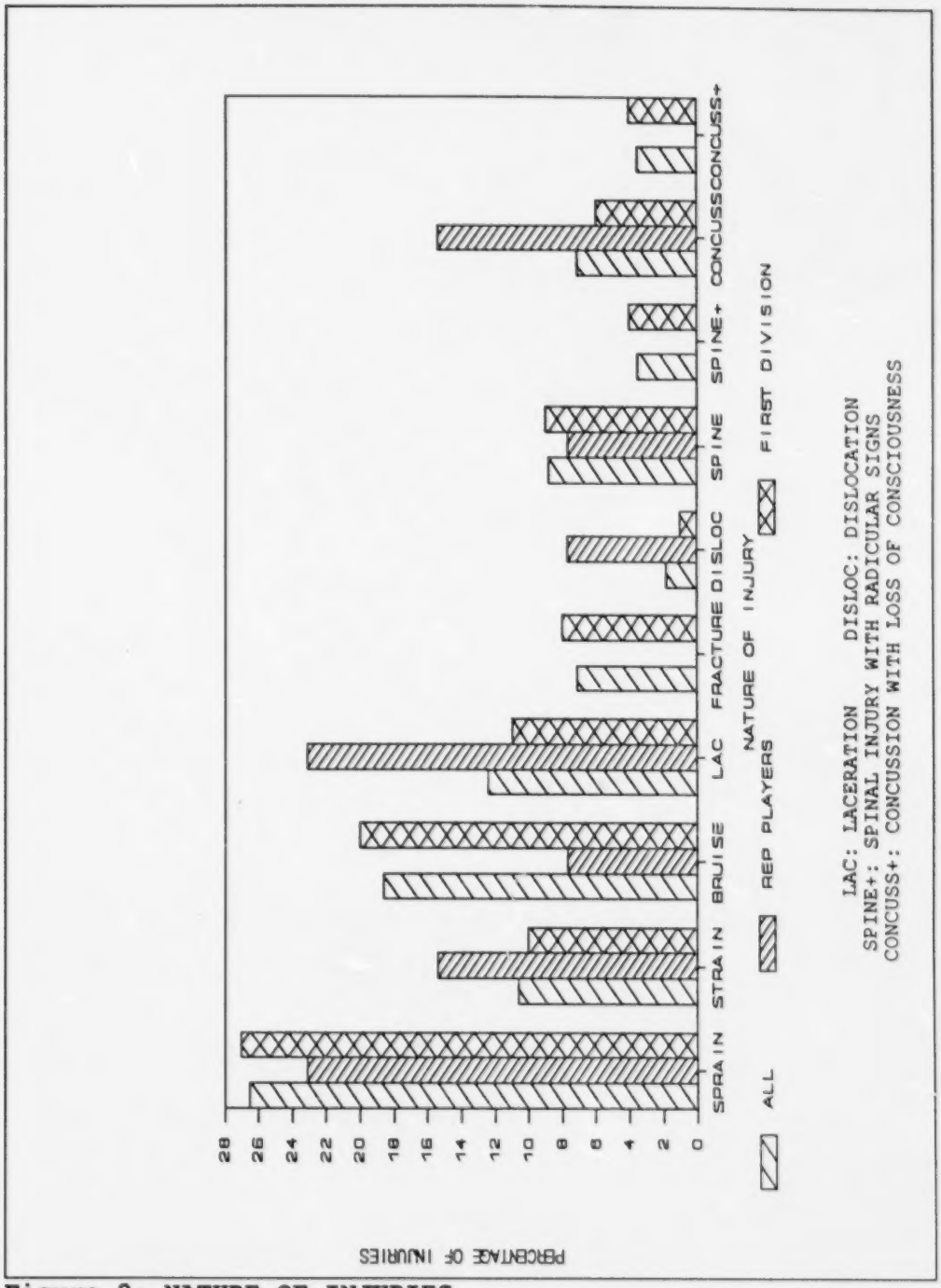



**Figure 2: NATURE OF INJURIES**

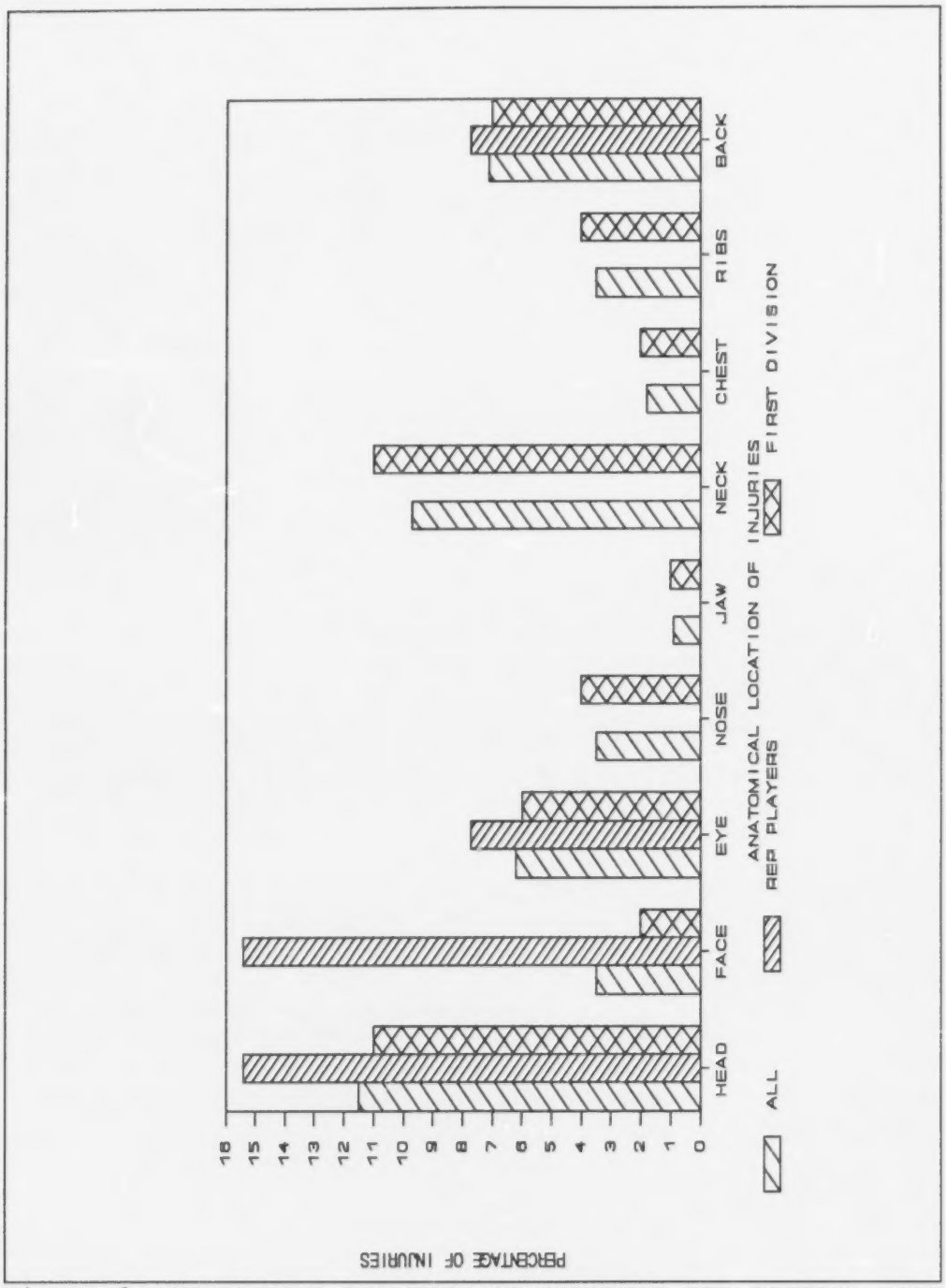



**Figure 3: ANATOMICAL LOCATION OF INJURIES FOR CENTRAL BODY AREAS**

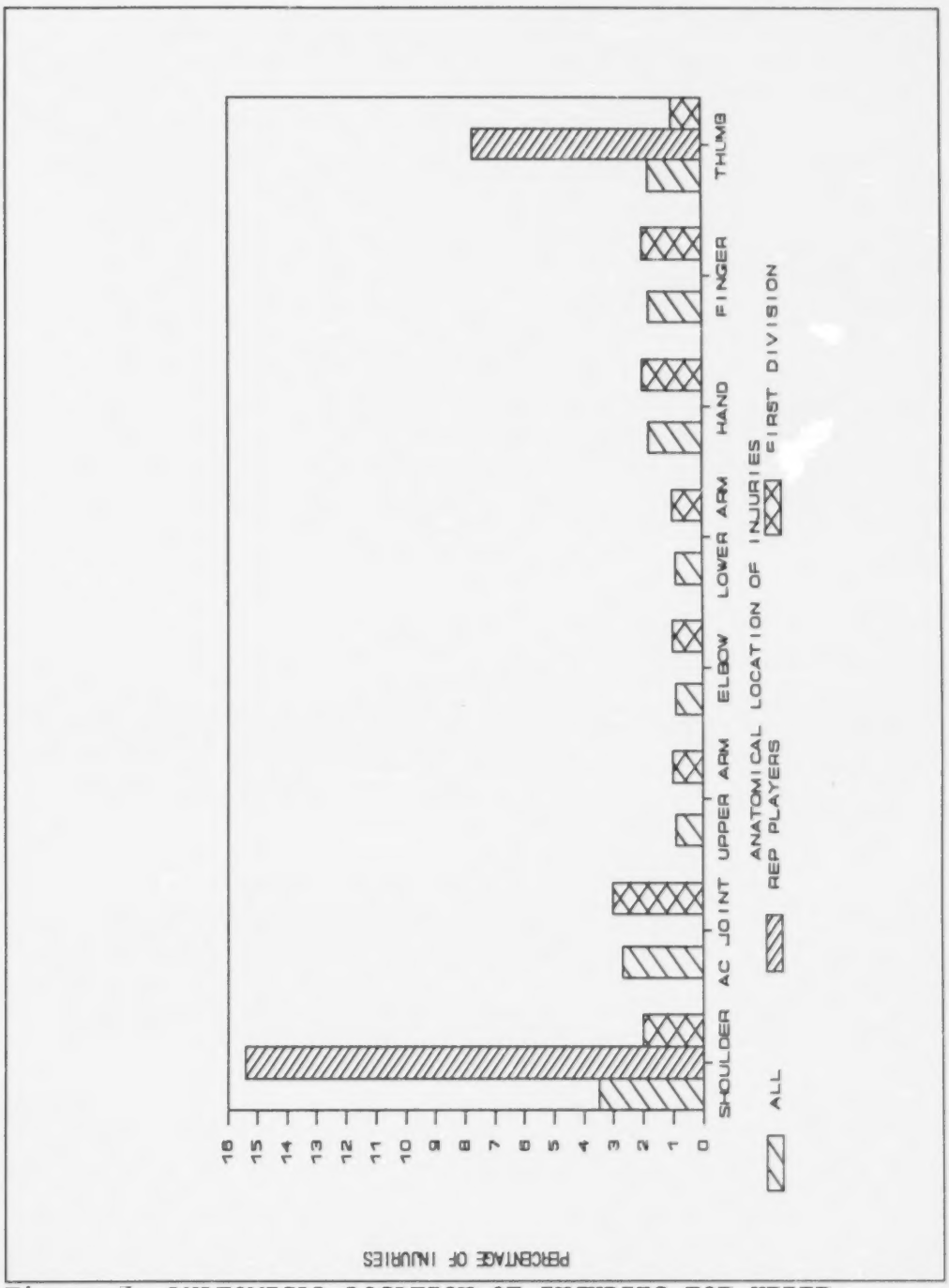



**Figure 4: ANATOMICAL LOCATION OF INJURIES FOR UPPER EXTREMITY**

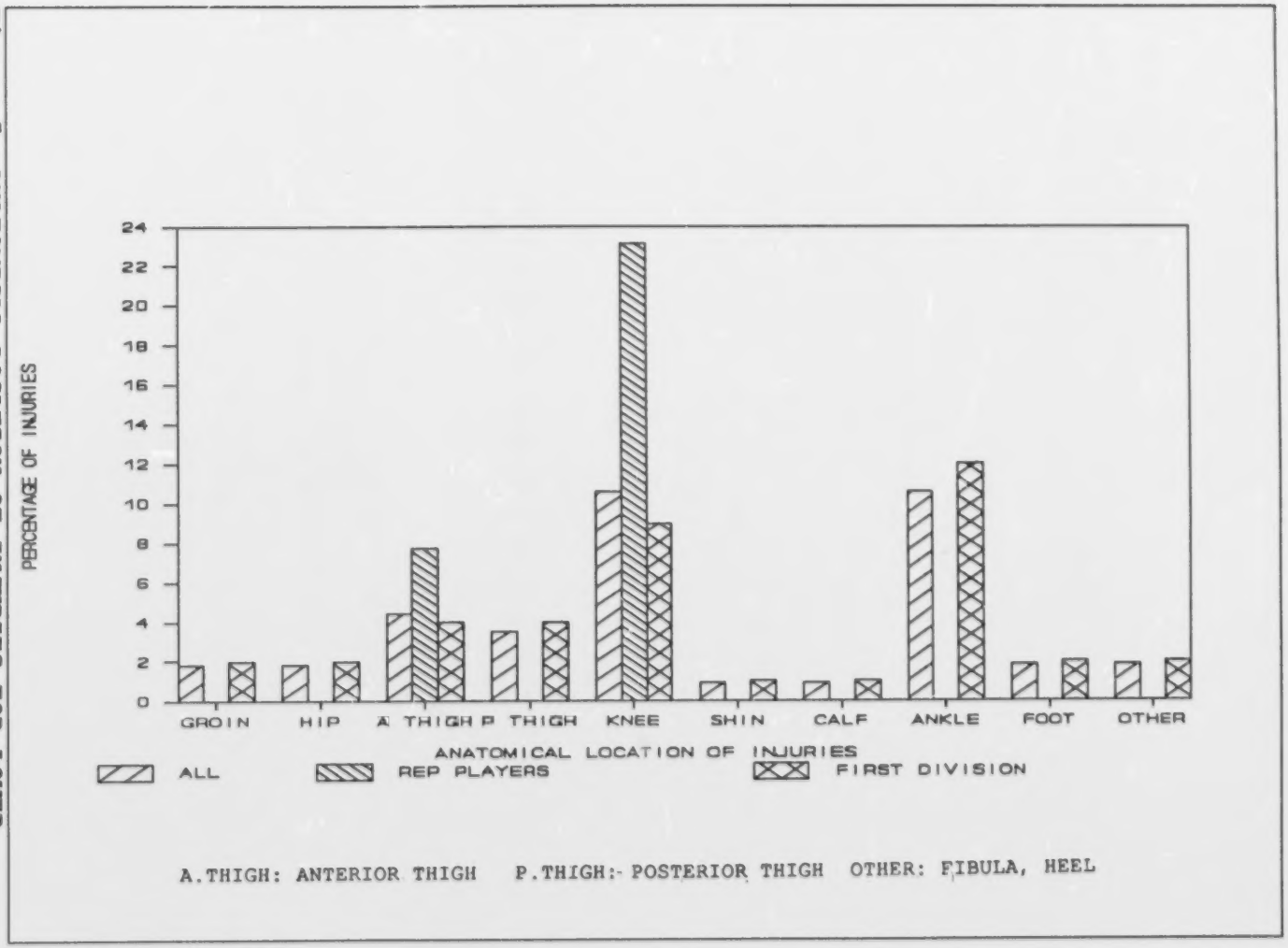



Figure 5: ANATOMICAL LOCATION OF INJURIES FOR LOWER EXTREMITY

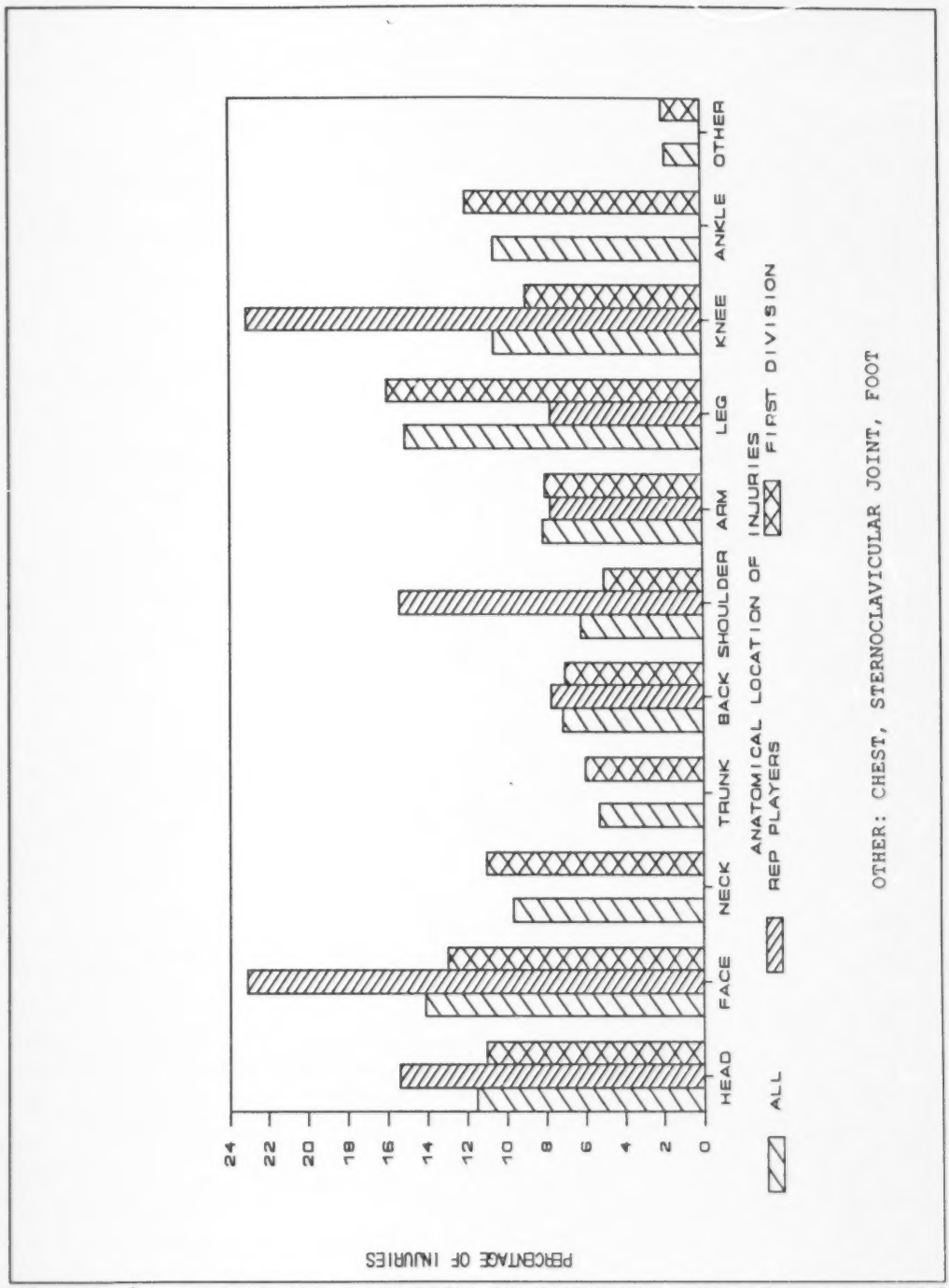



**Figure 6: ANATOMICAL LOCATION OF INJURIES FOR GENERAL AREAS**

**F) SEVERITY OF INJURY**

In this study, 45.9% (51 players) of all injured players did not complete the *game* in which the injury occurred, 35.1% (39 players) returned to the game, and 18.9% (21 players) did not lose any appreciable game time. Of representative team players, 46.2% (6 players) did not lose any game time, while 38.5% (5 players) did not complete the game. Statistics relating to first division players showed 46.9% (46 players) were unable to complete the game, 37.8% (37 players) returning to the game, and 15.3% (15 players) not losing any game time. These data are displayed in Figure 7.

Minimal time was lost from *future practices* due to injury with 28.2% (31 players) of all players losing no time, and 42.7% (47 players) and 14.5% (16 players) losing one and two weeks respectively, to account for 85.5% of all time lost. Representative team player injuries lead to 46.2% (6 players each) losing no time or one week, and 7.7% (1 player) losing two weeks to account for 100% of time lost. For first division players 25.8% (25 players) lost no time, 42.3% (41 players) lost one week and 15.5% (15 players) lost two weeks, accounting for 83.5% of the time lost. Complete data are displayed in Figure 8.

Similarly, minimal time was lost from *future games* due to injury. No future games were lost by 43.2% (48 players) of all players, while 27.9% (31 players) lost one week, and 13.5% (15 players) lost two weeks, for a total of 84.7% of the time

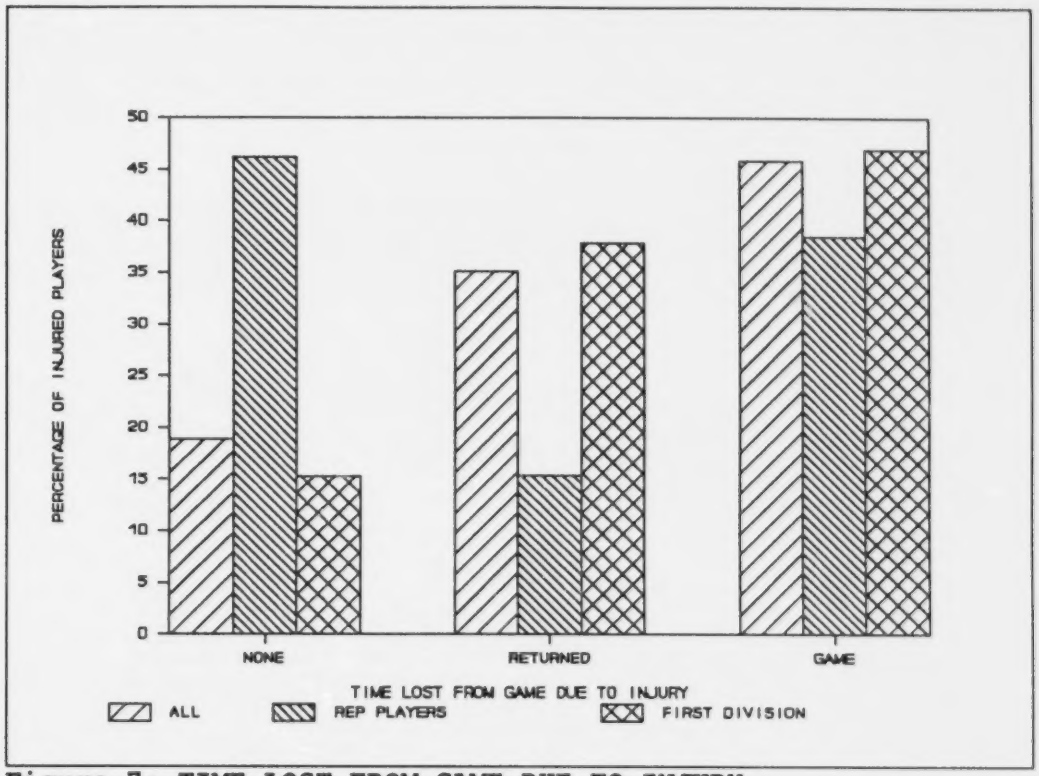



**Figure 7: TIME LOST FROM GAME DUE TO INJURY**

lost by injured players. Representative team player statistics had 61.5% (8 players) not missing future games, 30.8% (6 players) losing one week, and 7.7% (1 player) losing two weeks, for a total of 100% of time lost. First division player statistics had 40.8% (40 players) not missing future games, 27.6% (27 players) losing one week, and 14.3% (14 players) losing two weeks for a total of 82.7% of future game time lost. Figure 9 displays the complete data for future games lost due to injuries.

The above data would imply that although all of these injuries required some time lost from play or medical

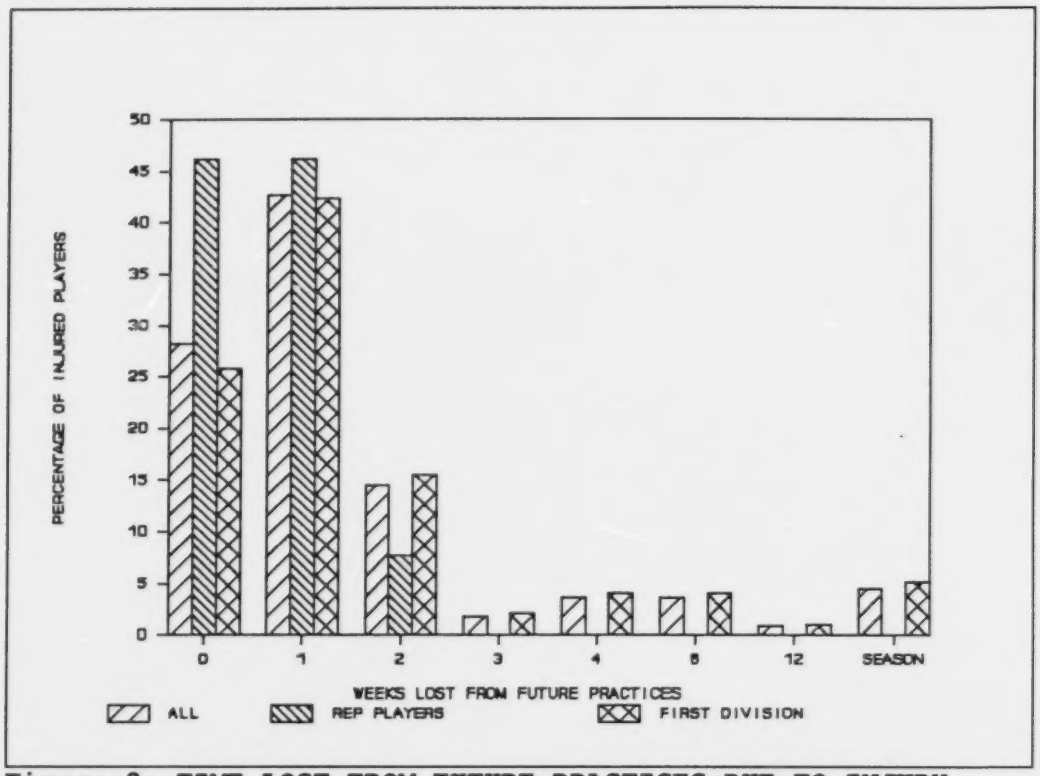



**Figure 8: TIME LOST FROM FUTURE PRACTICES DUE TO INJURY**

attention by definition, most were not of a serious nature. Of note, there were no representative team players who lost more than two weeks of future game or practice time due to injury, while over 14.0% (14 players) of first division players lost from one month to the rest of the season in terms of game and practice time. Minor injuries, causing one week or less time lost accounted for approximately 68.0% (67 players) of first division injuries, 92.3% (12 players) of representative team injuries, and approximately 71.0% (79 players) of overall injuries. Thus, the more serious injuries were sustained by first division players. This rate of time

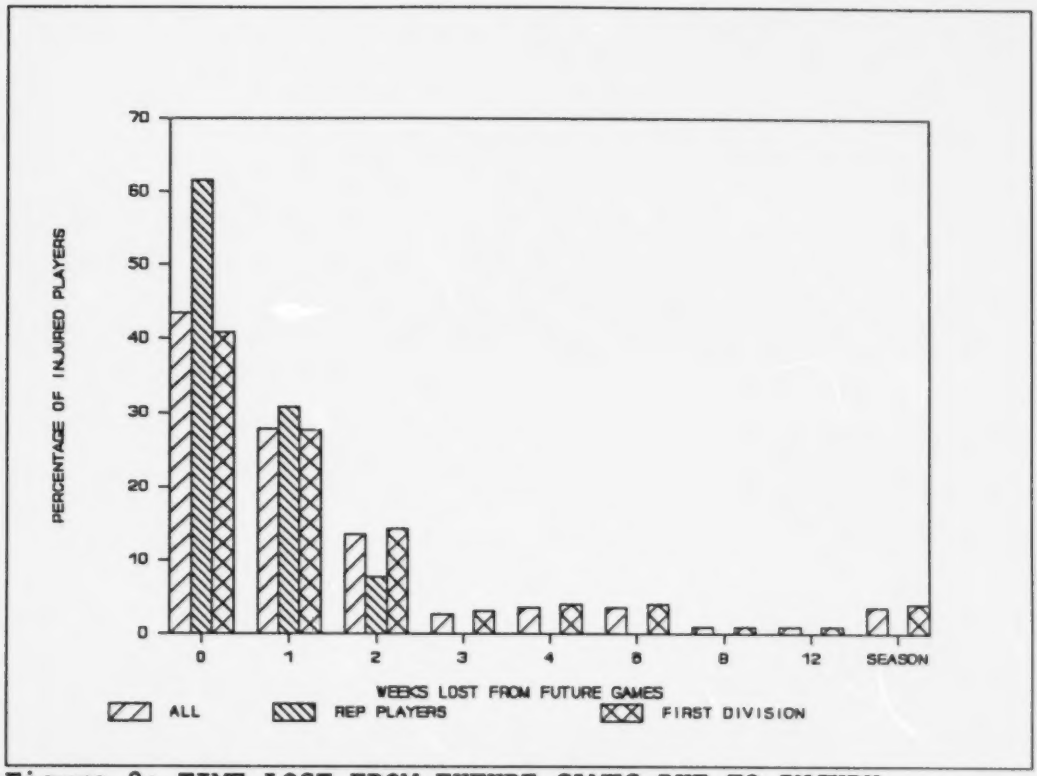



**Figure 9: TIME LOST FROM FUTURE GAMES DUE TO INJURY**

lost due to injury is much lower than found by Clark, Roux and Noakes(3). They reported 14.1% of players unable to play for less than one week, 13.5% for 8-14 days, 28.2% for two to four weeks, and 40.2% for one month to the rest of the season. Their definition of injury excluded players who did not miss any rugby due to injury, unless medical or surgical treatment was necessary or there was a concussion, thereby excluding many of the injuries included in this study.

## 2) GAME FACTORS

### A) INJURIES BY MONTH OF PLAY

Figure 10 displays the percentage of injuries by month. July (midseason) was the leading month with 35.9% (28 injuries) of the injuries occurring, while May (early season) had the least, with 12.8% (10 injuries) of the injuries. The trend was for injuries to peak mid-season only as found by Sugarman(18), rather than the double peak noted by Nathan,

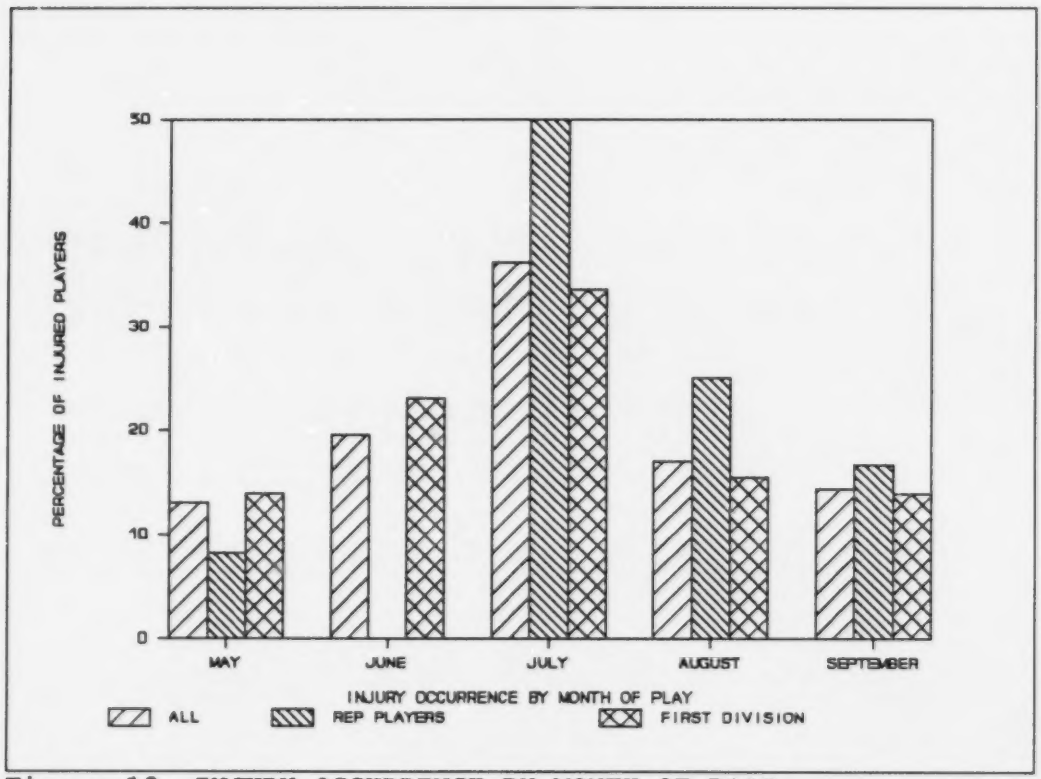



**Figure 10: INJURY OCCURRENCE BY MONTH OF PLAY**

Goedeke and Noakes(16), and Roux(17). Of note, the representative team had two games in each of May, July and

September, with no games in June, and one game in August.

**B) INJURIES BY TIME IN GAME**

Most of the injuries occurred in the second (28.8% or 32 injuries) and fourth quarters of the games (23.4% or 26 injuries) for all players. Most injuries occurred in the second quarter of the game (46.2% or 6 injuries) for representative team players, and there was a slightly higher incidence in the second quarter of the game (26.5% or 26 injuries) for first division players. One team did not record injuries by the quarter of the game, but by the half of the game, thus data are also displayed in this configuration. Figure 11 displays these data. The literature reviewed had mixed findings, with Addley and Farren(2) also finding second and fourth quarter peaks, Davies and Gibson(11) finding peaks in the third and fourth quarters of the game, and Roy(8) finding a single peak in the third quarter of the game.

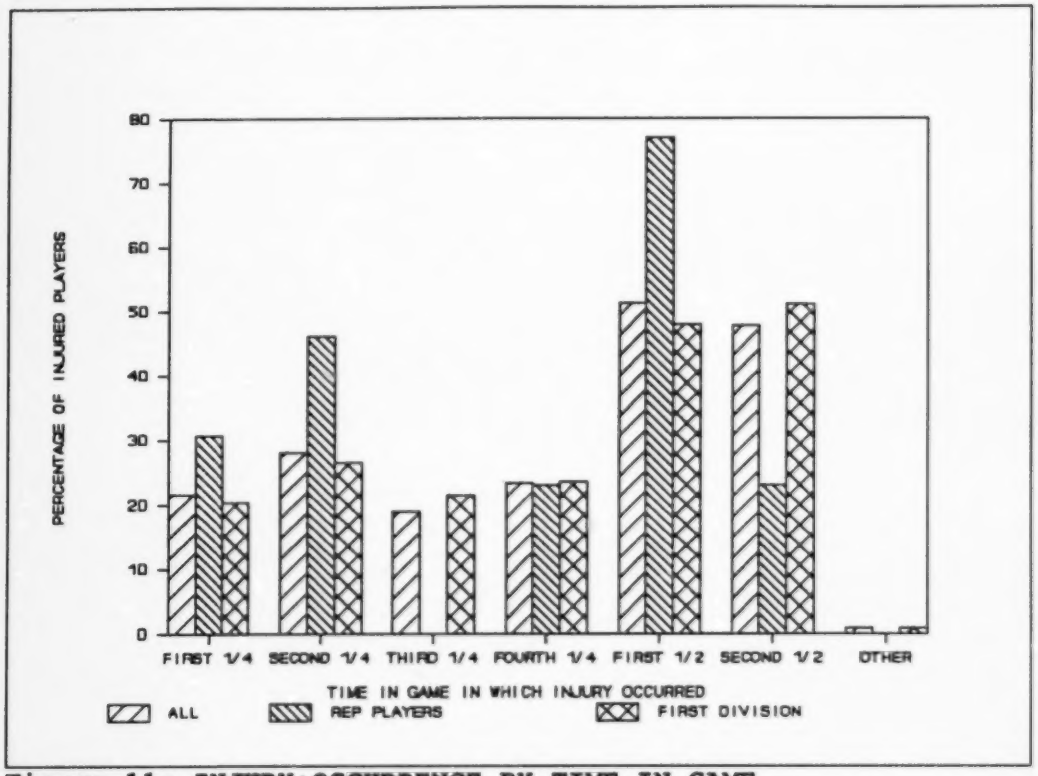



**Figure 11: INJURY OCCURRENCE BY TIME IN GAME**

## 3) RISK FACTORS

### A) CERVICAL SPINE INJURIES

There were a total of 11 injuries to the neck (9.6% of all injuries). Of these, 9 (81.9%) were spinal injuries and 2 (18.2%) were strains. Of the spinal injuries, 44.4% (4) involved neurological signs. Figure 12 illustrates these data.

Flankers and centres each accounted for 27.3% (3

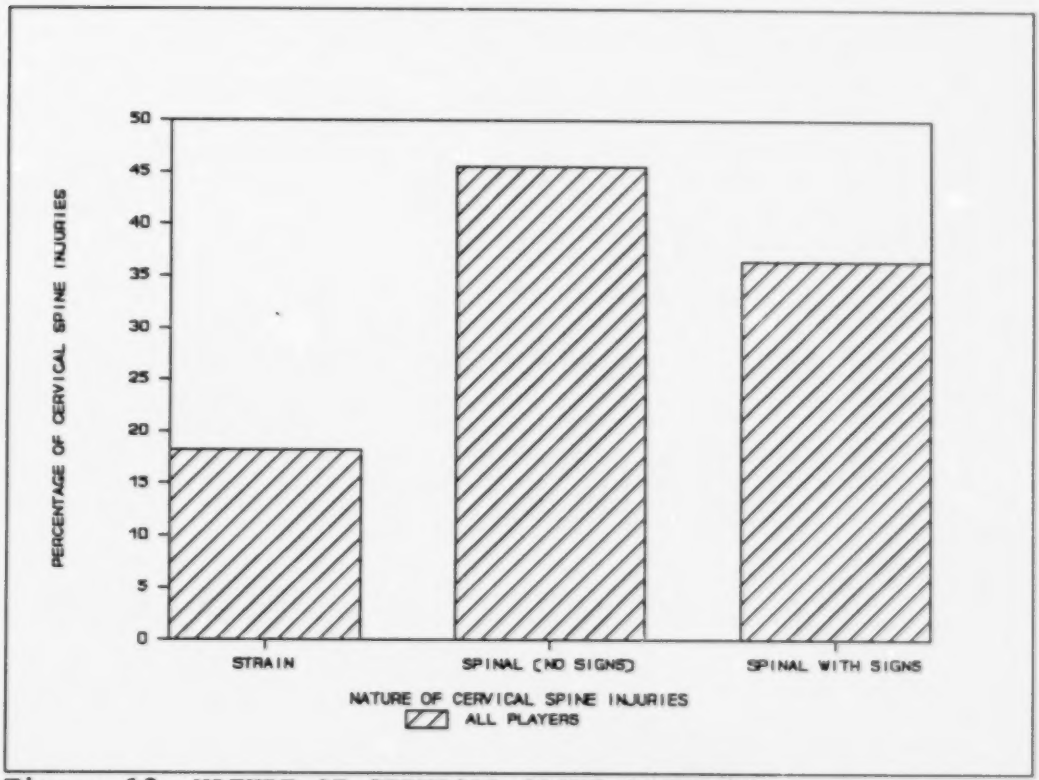



**Figure 12: NATURE OF CERVICAL SPINE INJURIES**

injuries) of the injuries to the neck, while outside halves had 18.2% (2 injuries). The rest of the neck injuries were to props, second row, and number 8, at 9.1% each (or one injury

each). Figure 13 illustrates these data.

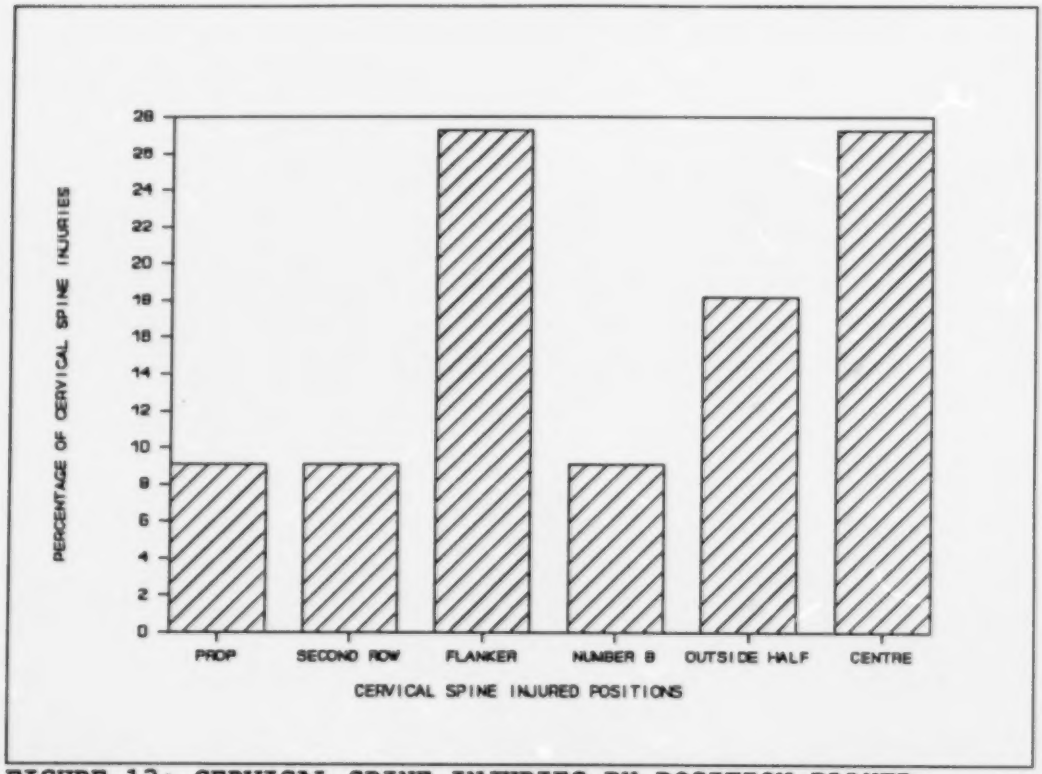



**FIGURE 13: CERVICAL SPINE INJURIES BY POSITION PLAYED**

The most frequent cause of neck injury was a direct blow or overstretching (27.3% or 3 injuries each). Rotation and compression forces each accounted for 18.2% (2 injuries) of the neck injuries. The other injury was a whiplash caused by pulling on the ball carrier's jersey. Figure 14 illustrates the causes of cervical spine injuries.

It is notable that, no neck injuries occurred as a result of scrummaging. However, 45.5% (5 injuries) occurred in rucks and mauls, with engaging and driving accounting for 18.2% (2 injuries) each and collapsing the other 9.1%. Tackling and

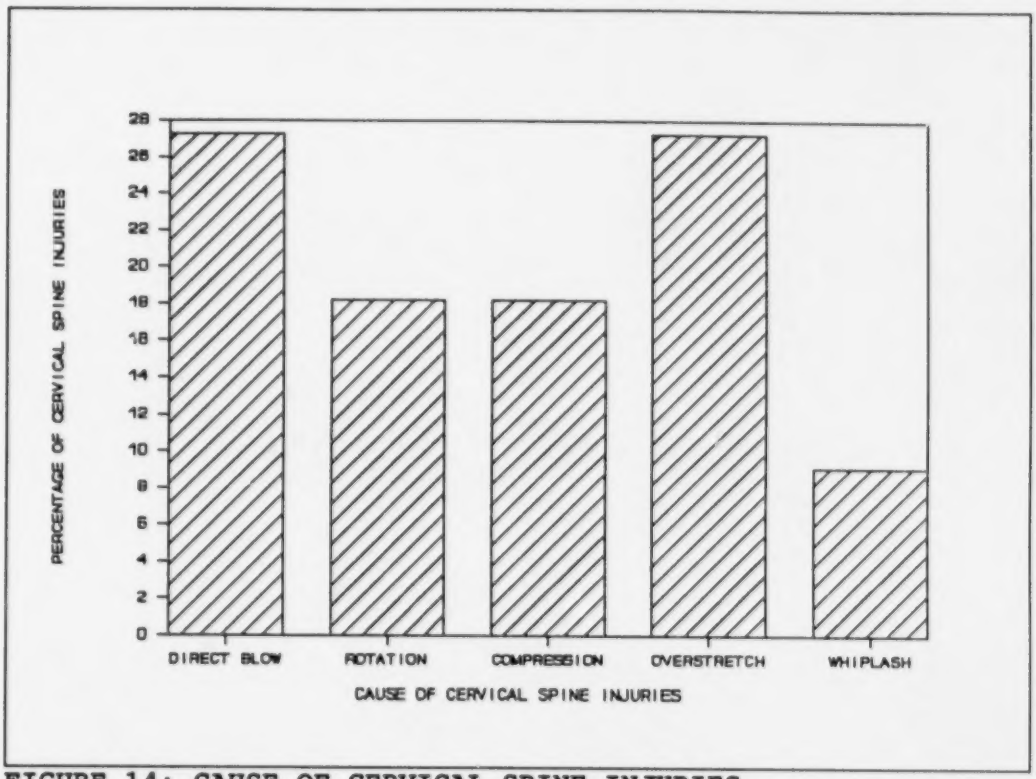



**FIGURE 14: CAUSE OF CERVICAL SPINE INJURIES**

being tackled each accounted for 27.3% (3 injuries) of these injuries. Figure 15 illustrates the occurrence of cervical spine injuries by phase of play. Forty five percent (5 injuries) of these injuries occurred during the fourth quarter of the game, while 18.2% (2 injuries) occurred during the first quarter of the game. Overall, 72.8% (8 injuries) of the neck injuries occurred during the second half of the game. Therefore, fatigue may be a factor in neck injuries. Figure 16 illustrates the time during the game that cervical spine injuries occurred. These injuries caused 27.3% (3 players) of the players to not finish the game, but 36.4% (4 players) did

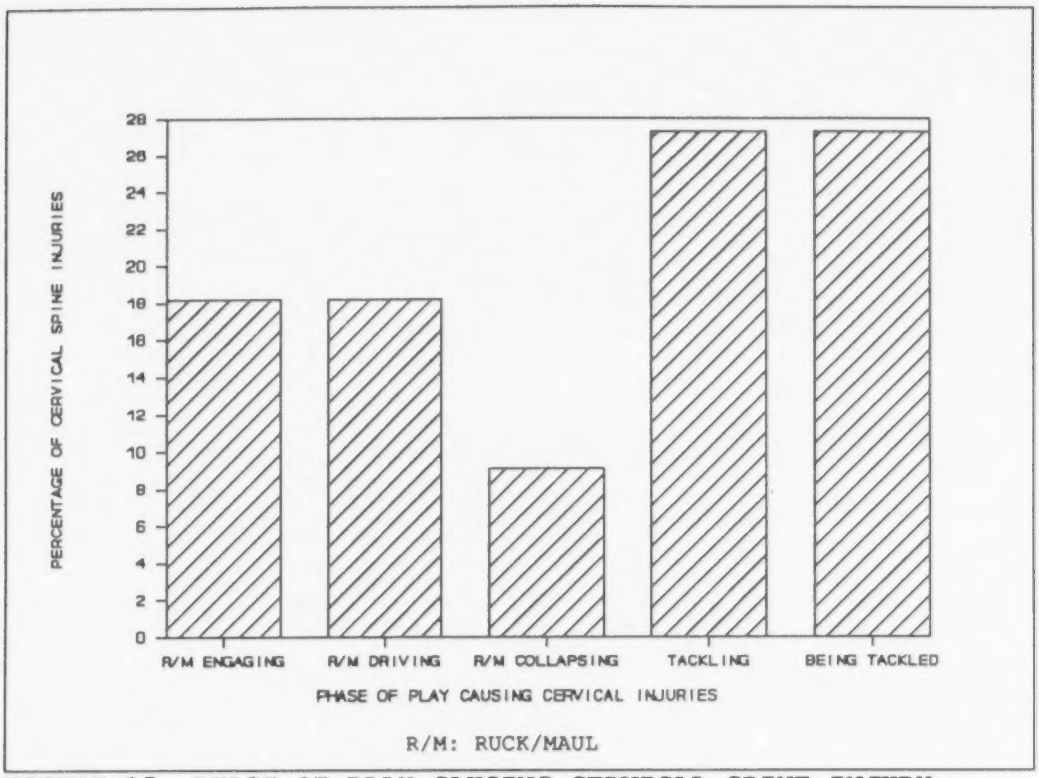



**FIGURE 15: PHASE OF PLAY CAUSING CERVICAL SPINE INJURY**

return to the game after examination. One week of practice was lost due to neck injury for 63.6% (7 players) of these players, while 18.2% (2 players) lost two or three weeks. Most players (72.7% or 8 players) did not miss any games, while 9.1% (1 player) lost each of one to three weeks of games. Figure 17 illustrates the time lost from play, future practices and games due to cervical spine injury.

## B) INJURIES BY PHASE OF PLAY

Being tackled was the leading cause of injuries (25.7% or 29 injuries) for all players. There were 14 causes of

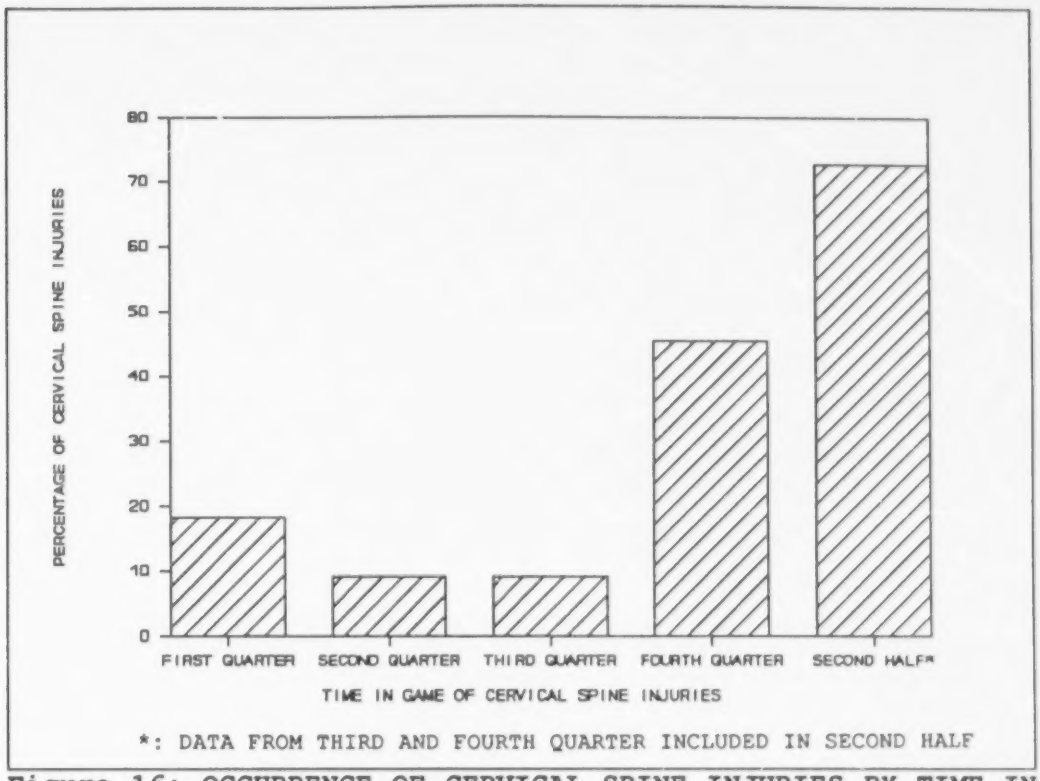



**Figure 16: OCCURRENCE OF CERVICAL SPINE INJURIES BY TIME IN GAME**

injuries recorded with rucks or mauls accounting for 23.1% (26 injuries), tackling 13.3% (15 injuries), running 11.5% (13 injuries), open play 9.7% (11 injuries), and scrummages 8.9% (10 injuries) of injuries. Figure 18 illustrates these data.

Representative team players had seven causes of injury, with being tackled the cause of 53.8% (7 injuries) of the injuries. All other causes were evenly reported at 7.7% (1 injury), including scrummages, rucks/mauls, line outs, running and open play.

First division players had 14 causes of injuries, with

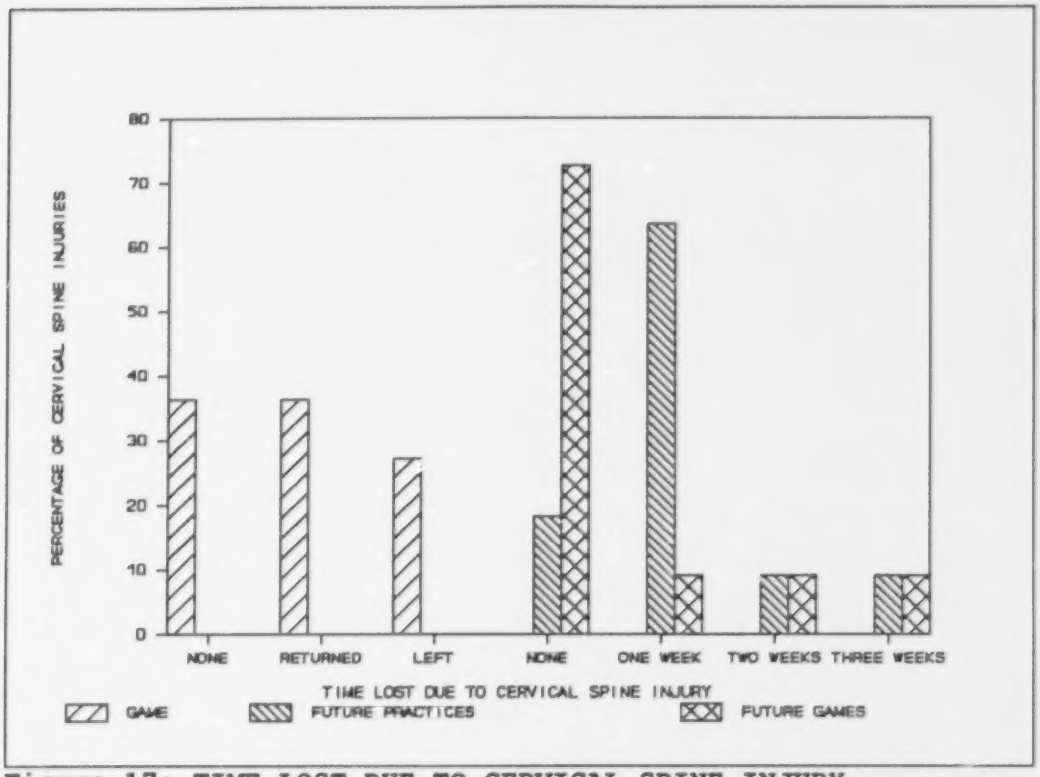



**Figure 17: TIME LOST DUE TO CERVICAL SPINE INJURY**

rucks/mauls causing 25.0% (25 injuries). Being tackled caused 22.0% (22 injuries), tackling 15.0% (15 injuries), running 12.0% (12 injuries), open play 10.0% (10 injuries), and scrummages 9.0% (9 injuries) of the injuries.

The more exclusive causes of injury for representative players occurs with the higher skill level of the players. Their game is faster, the contact harder and more precise, making tackles more aggressive. There should be fewer self-inflicted injuries at this level of play (for example, overstretching, overstraining, tripping), as supported by the findings.

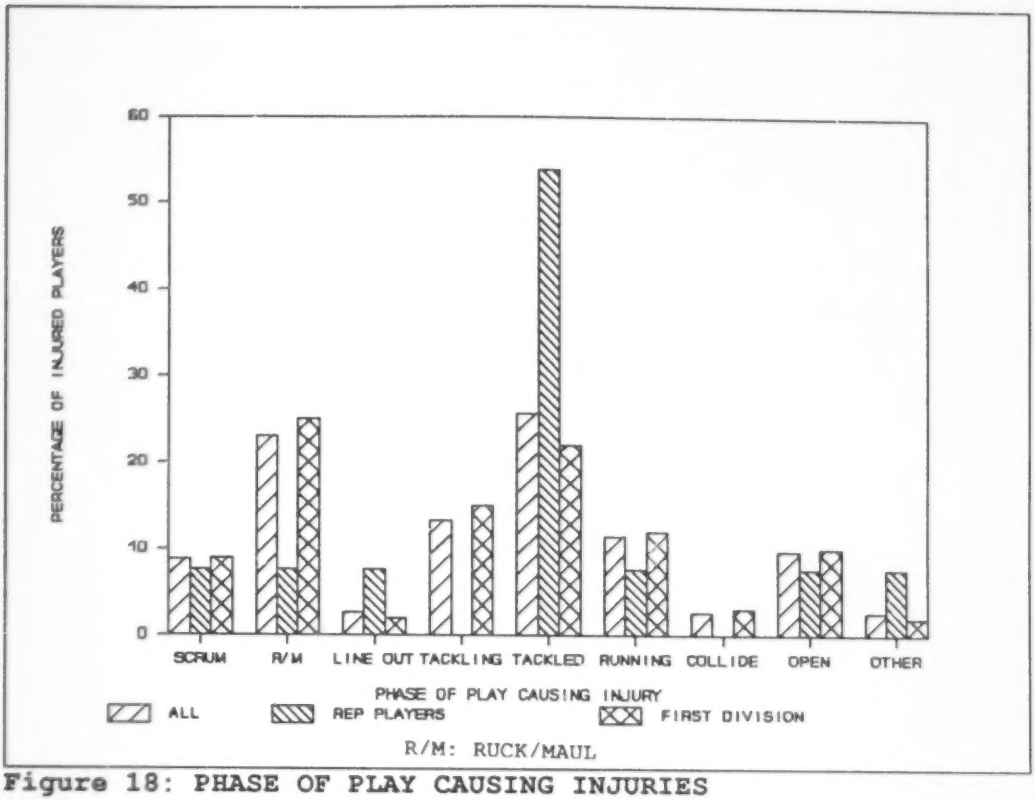



**Figure 18: PHASE OF PLAY CAUSING INJURIES**

These general trends of injury, with player contact phases of tackles and rucks/mauls having the highest incidence of injury, agrees with the literature reviewed.

## C) INJURIES BY BALL POSSESSION

The ball was involved during 80.7% (88 injuries) of the play when injuries occurred. Representative player injuries involved the ball 84.6% (11 injuries) of the time and first division injuries 80.2% (77 injuries) of the time. These data indicates that foul play (such as late tackles) was probably not a factor in the majority of injuries at any level of

play,but does not rule out foul play during ball-involved play such as scrummages, rucks and mauls.

**D) INJURIES BY POSITION PLAYED**

*Props** accounted for 12.3% (14 injured players) of all injured players, and 66.7% (14 props) of all props were injured (* denotes any player position which includes two players on the field at the same time during a game). However, props accounted for 15.4% (2 injured players) of representative team injuries and only 11.9% (12 injured players) of first division injuries. Figure 19 shows the percentage of total injuries for the positions played. Figure 20 shows the percentage of injured players for each position played.

The most common type of injury sustained by props was contusions for 23.1% (3 injuries) of their injuries. Sprains, lacerations/abrasions, fractures and spine injuries without radicular signs each comprised 15.4% (2 injuries) of the prop injuries. Figure 21 illustrates the nature of injuries for forwards.

Prop injuries were primarily to the back (15.4% or 2 injuries) with other injuries occurring equally to areas of the eye, neck, shoulder, arm, hand, and leg. Figure 22 illustrates the location of injuries to forwards.

Prop injuries were primarily caused by a direct blow (53.8% or 7 injuries), with twisting force and overstretching

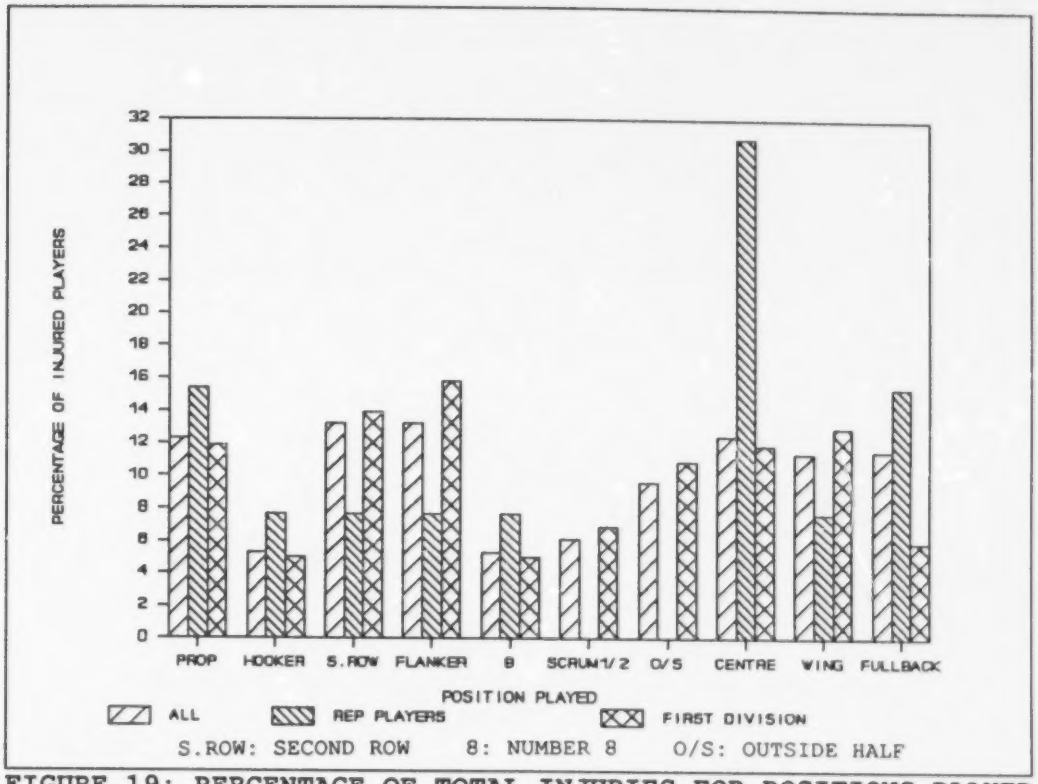



**FIGURE 19: PERCENTAGE OF TOTAL INJURIES FOR POSITIONS PLAYED**

causing 15.4% (2 injuries) of the injuries each. Figure 23 illustrates the cause of injuries to forwards.

*Hookers* accounted for 5.3% (6 injured players) of all injured players and 46.2% (6 hookers) of hookers were injured. They accounted for 7.7% (1 injured player) of representative team injuries and 5.0% (5 injured players) of first division injuries. Injuries to hookers were evenly divided between sprains, contusions and spine injuries without radicular signs. Their injuries occurred primarily to the back (33.3% or 2 injuries), with the chest, anterior thigh, knee and ankle areas all accounting for 16.7% (1 injury) of their injuries.

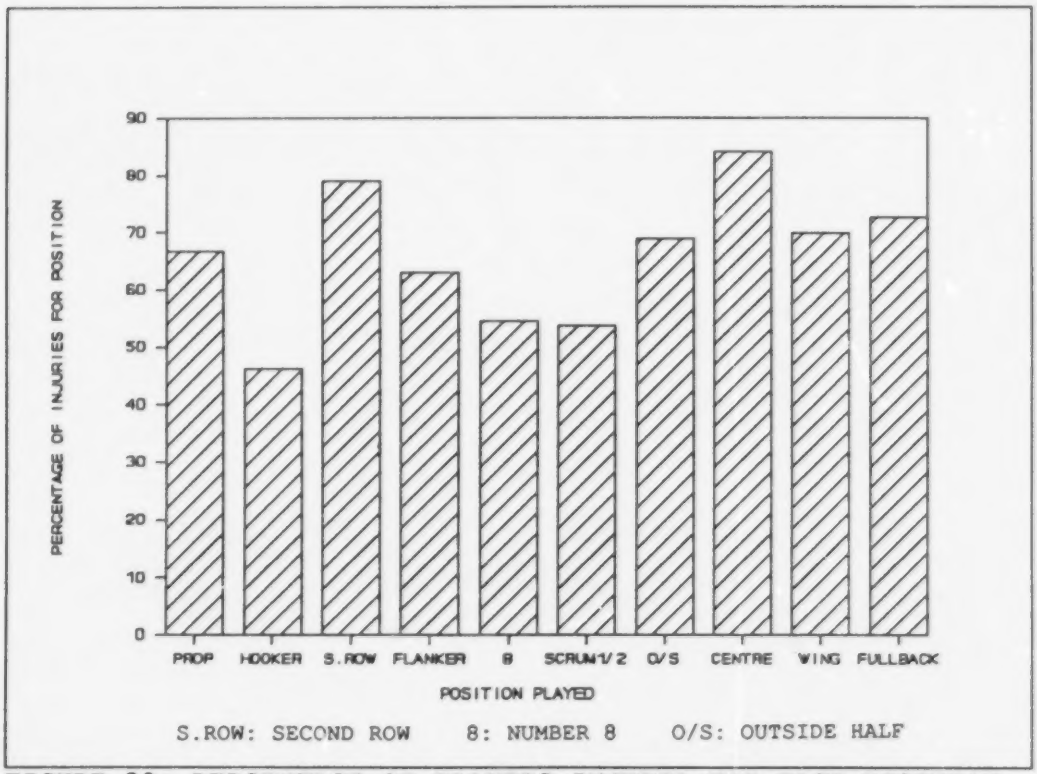



**FIGURE 20: PERCENTAGE OF PLAYERS INJURED FOR EACH POSITION**

Their injuries were primarily caused by direct blows (66.7% or 4 injuries), with twisting and compression forces causing 16.7% (1 injury) each.

*Second row* players* accounted for 13.2% (15 injured players) of all injured players and 78.9% (15 second row) of all second row players were injured. They accounted for 7.7% (1 injured player) of representative team injuries but 13.9% (14 injured players) of first division injuries. Second row players primarily received laceration/abrasion injuries (33.3% or 5 injuries). Sprains accounted for 20.0% (3 injuries) and concussions with loss of consciousness for 13.3% (2 injuries)

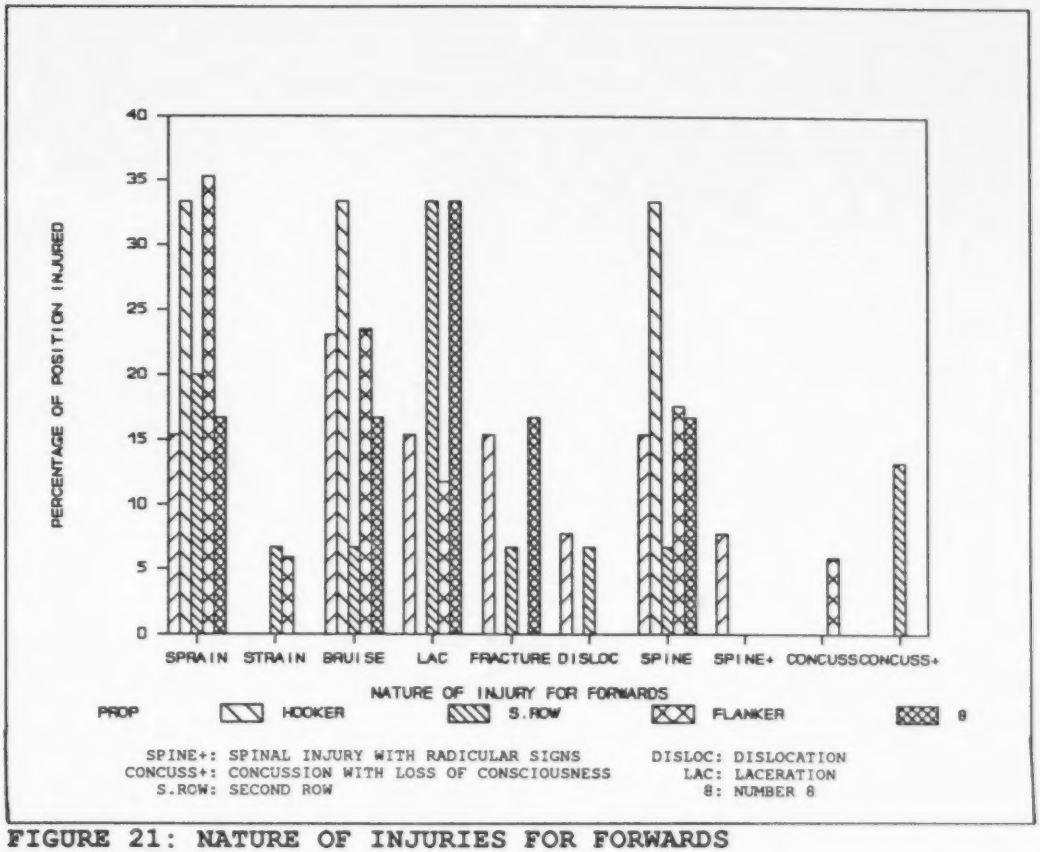



**FIGURE 21: NATURE OF INJURIES FOR FORWARDS**

of injuries, with four other causes accounting for the remaining 33.3%. The head, face, eye and shoulder areas each accounted for 13.3% (2 injuries) of the injured areas, with seven other areas accounting for the remaining 46.8%. The primary cause of second row injury was a direct blow (53.3% or 8 injuries), with compression force causing 20.0% (3 injuries), landing 13.3% (2 injuries) , and twisting and overstretching each causing 6.7% (1 injury).

*Wing forwards* (flankers)* accounted for 13.2% (15 injured players) of all injured players and 63.0% (17 flankers) of

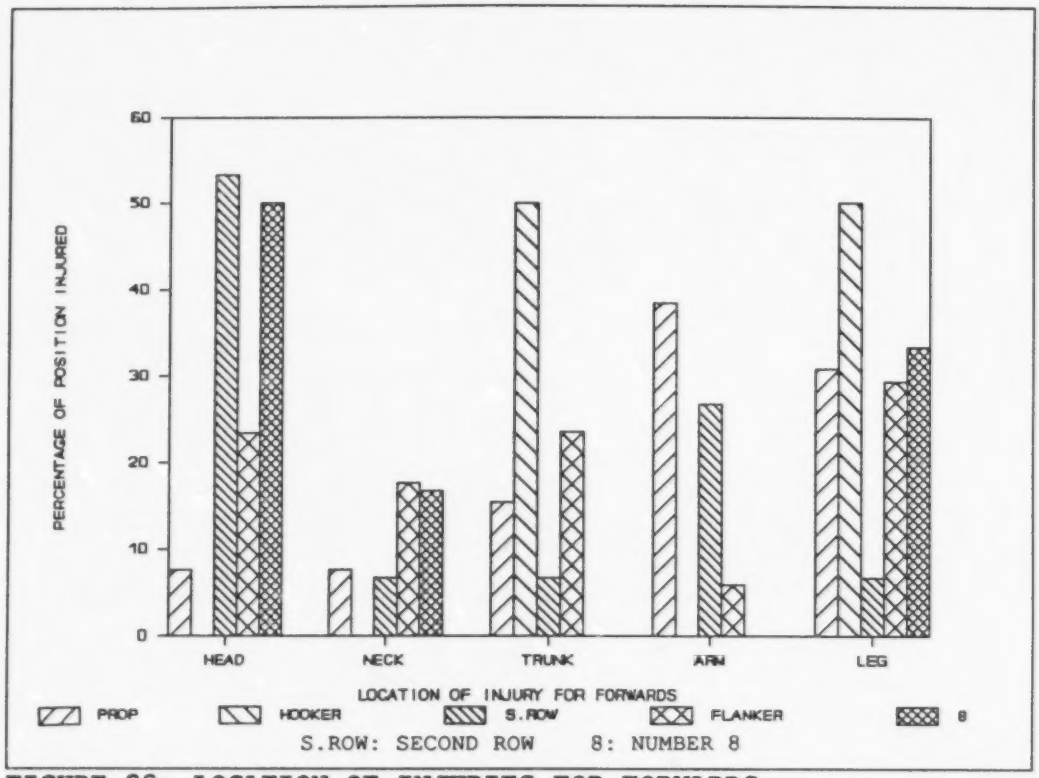



**FIGURE 22: LOCATION OF INJURIES FOR FORWARDS**

flankers were injured. They accounted for 7.7% (1 injury) of representative team injuries but 13.9% (14 injured players) of first division injuries. Sprains comprised 35.3% (6 injuries) of injuries to flankers. Contusions comprised 23.5% (4 injuries), spine injuries without radicular signs comprised 17.6% (3 injuries), lacerations comprised 11.8% (2 injuries), and concussions without loss of consciousness and strains each comprised 5.9% (1 injury) of the injuries. Neck and ankle injuries each accounted for 16.7% (1 injury) of the areas injured, while back injuries accounted for 11.8% (2 injuries) of the areas injured. The rest of the injuries occurred

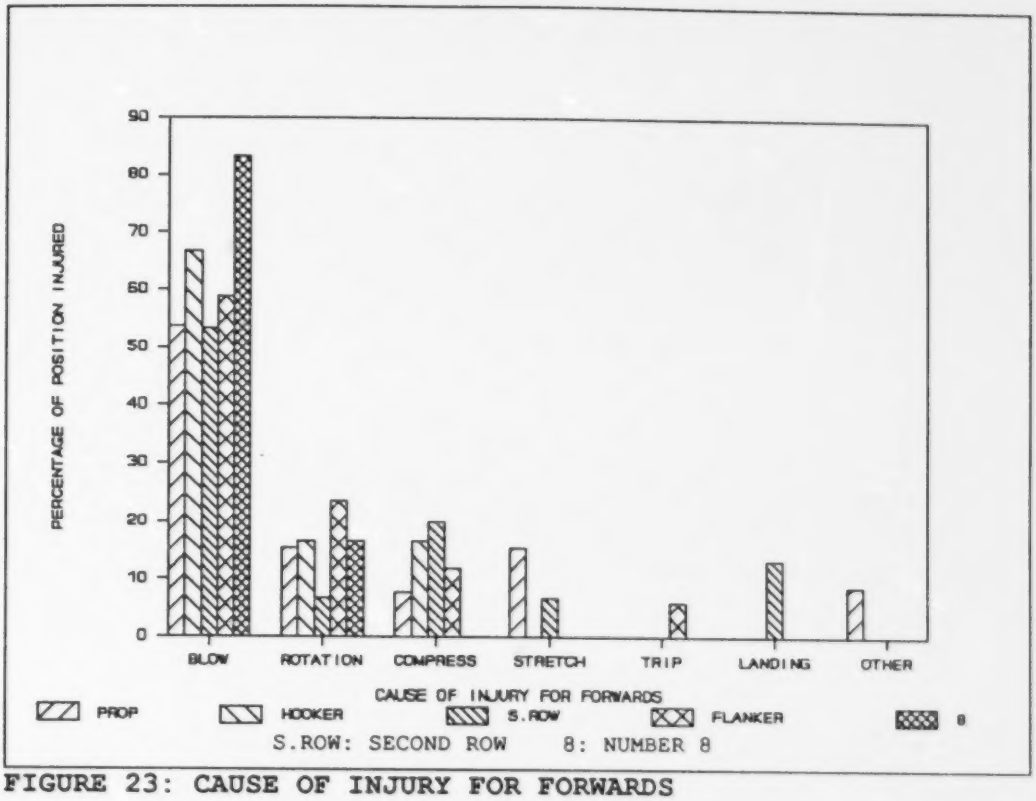



**FIGURE 23: CAUSE OF INJURY FOR FORWARDS**

equally in nine other areas. The main cause of injury to flankers was a direct blow (58.8% or 10 injuries). Twisting forces caused 23.5% (4 injuries), compression forces caused 11.8% (2 injuries), and tripping caused 5.9% (1 injury) of the injuries.

*Number eights* accounted for 5.3% (6 injured players) of all injuries but 54.5% (6 number 8) of number eights were injured. They accounted for 7.7% (1 injury) of representative team injuries and 5.0% (5 injury) of first division injuries. Lacerations constituted 33.3% (2 injuries) of the injuries to number eights. Sprains, contusions, fractures, and spine

injuries without radicular signs each included 16.7% (1 injury) of the remaining types of injuries. These injuries were 33.3% (2 injuries) to the eye, and 16.7% (1 injury) to each of the nose, neck, ankle and foot. Direct blows caused 83.3% (5 injuries) of the injuries, and the other was from twisting forces.

*Scrumhalves* accounted for 6.1% (7 injured players) of all injuries and 53.8% (6 scrumhalves) of all scrumhalves were injured. No representative team scrum half was injured but they accounted for 6.9% (7 injured players) of first division injuries. Scrumhalf injuries were 28.6% (2 injuries) each of sprains, strains and contusions. Fractures accounted for the remaining 14.3% (1 injury). Figure 24 illustrates the nature of injuries for backs.

Scrumhalf injuries were equally dispersed to ribs, acromio-clavicular joints, hands, thumbs, posterior thighs, knees and ankles. Figure 25 illustrates the location of injuries for backs. They were caused by a direct blow in 28.6% of the cases, and by five other forces for 14.3% each. Figure 26 illustrates the cause of injuries for backs.

*Outside halves* (O/S) accounted for 9.6% (11 injured players) of all injuries and 68.8% (11 outside halves) of all outside halves were injured. They accounted for 10.9% (11 injured players) of first division injuries and none of representative team injuries. Sprains, strains, lacerations, spine injuries with radicular signs and concussions each

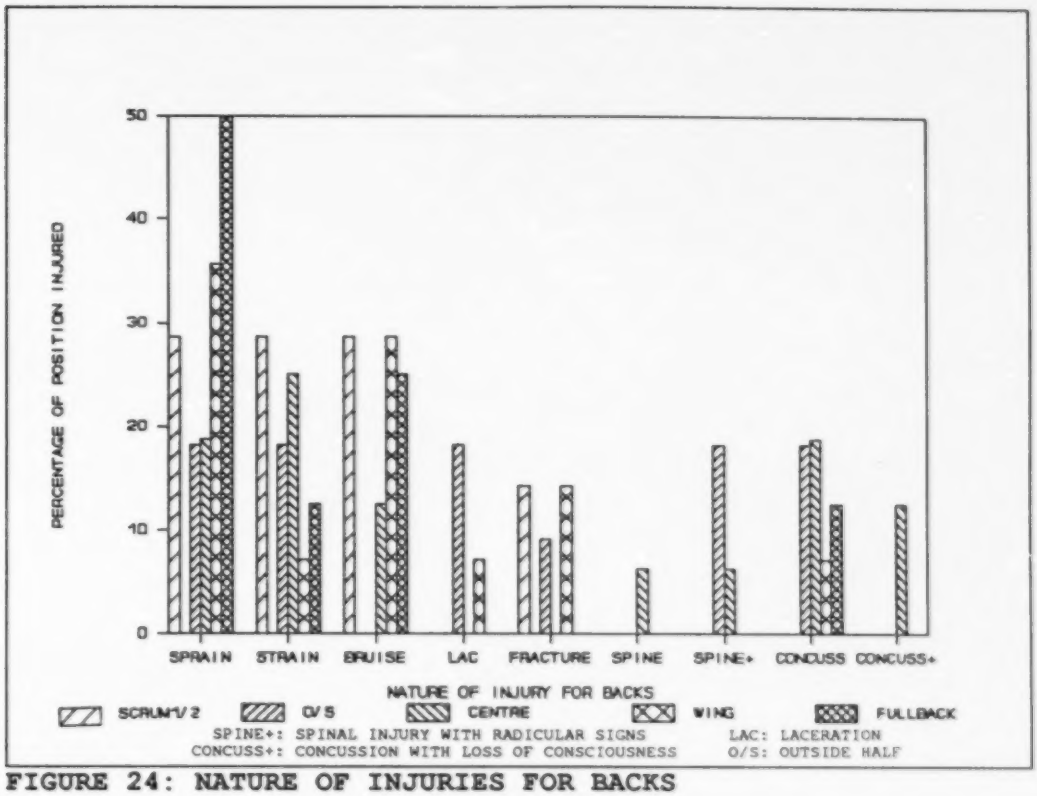



**FIGURE 24: NATURE OF INJURIES FOR BACKS**

accounted for 18.2% (2 injuries) of injuries to the outside half. Fractures accounted for 9.1% (1 injury). The head was the most common area of injury (27.3% or 5 injuries), followed by the neck (18.2% or 2 injuries). The eye, nose, groin, posterior thigh, knee and ankle each accounted for 9.1% (1 injury) of the injuries. Direct blow and overstretching caused 36.4% (4 injuries) of the injuries each, with twisting, overstraining and landing each causing 9.1% (1 injury).

*Centres** accounted for 12.4% (17 injured players) of all injuries but 84.2% (16 centres) of all centres were injured. They accounted for 30.8% (4 injuries) of all representative

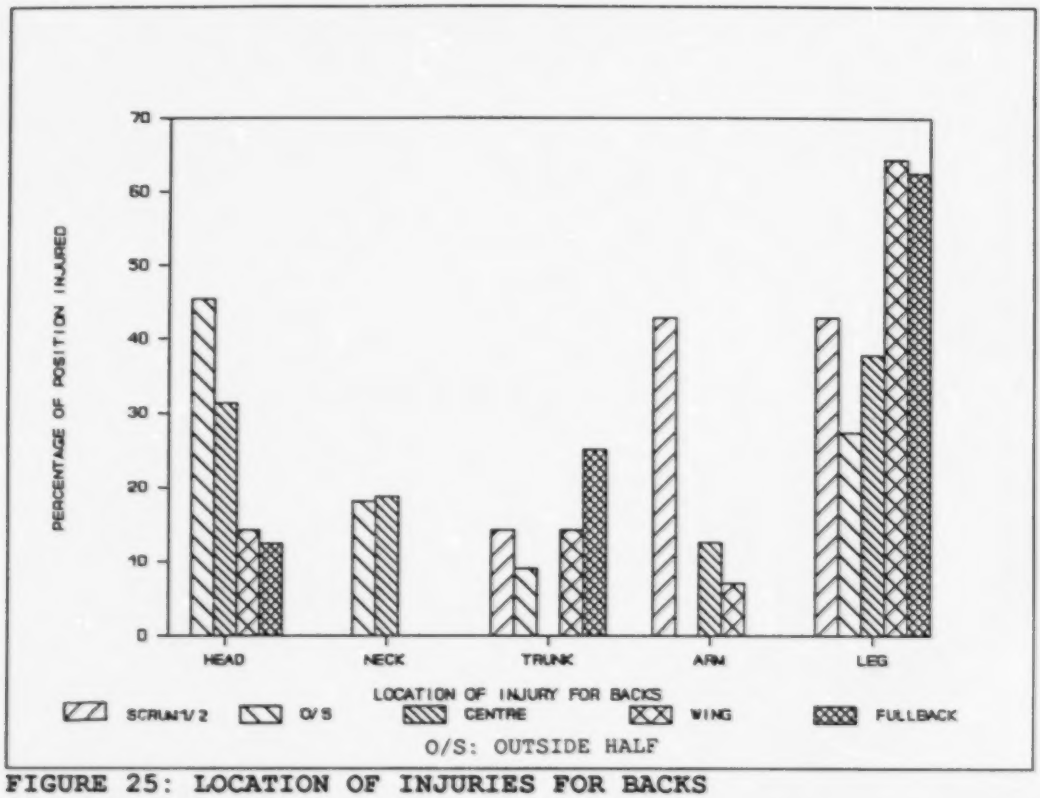



**FIGURE 25: LOCATION OF INJURIES FOR BACKS**

team injuries but only 11.9% (10 injuries) of first division injuries. Centres suffered strains as 25.0% (4 injuries) of their injuries. Sprains and concussions without loss of consciousness each accounted for 18.8% (3 injuries), while contusions and concussions with loss of consciousness each accounted for 12.5% (2 injuries). Thus, concussions totalled 31.3% (5 injuries) of all injuries to centres. Spine injuries combined to 12.6% (2 injuries) of their injuries. Consequently, 31.3% (5 injuries) of their injuries were to the head, with 18.8% (3 injuries) to each of the face and anterior thigh. Direct blows caused 50.0% (8 injuries) of these

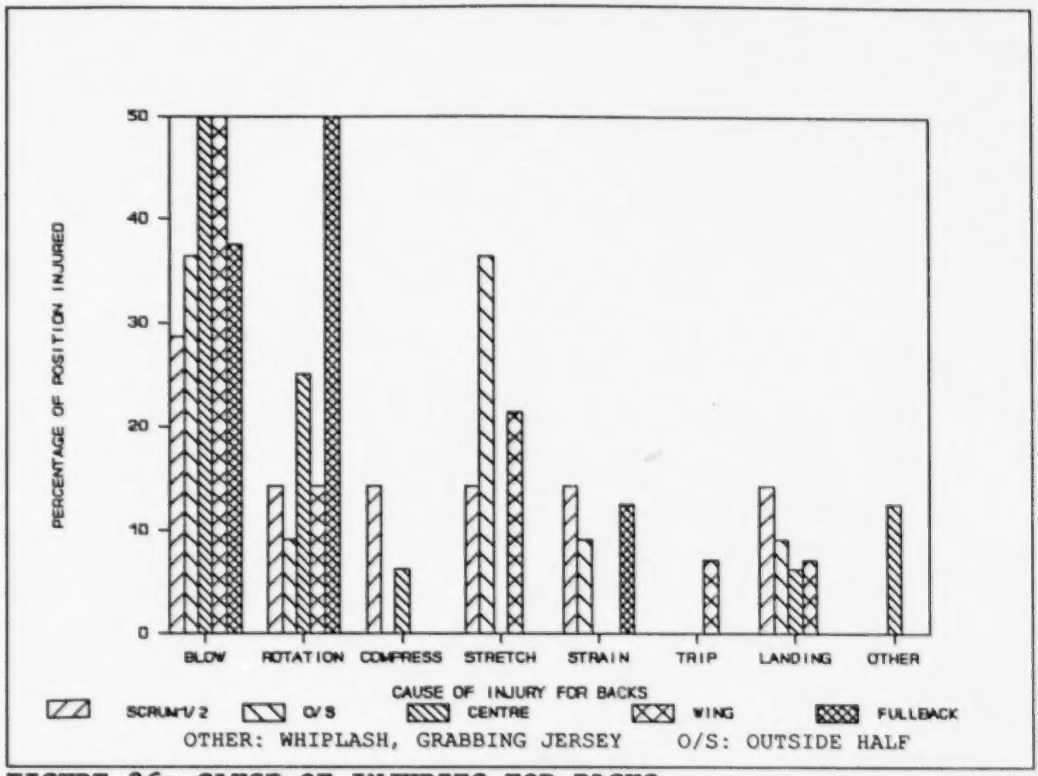



**FIGURE 26: CAUSE OF INJURIES FOR BACKS**

injuries, with twisting force causing 25% (4 injuries).

*Wingers** accounted for 11.4% (13 injured players) of all injuries but 70.0% (14 wingers) of all wingers were injured. They accounted for only 15.4% (2 injuries) of representative team injuries but 10.9% (11 injuries) of first division injuries. Wingers sustained primarily sprain injuries (35.7% or 5 injuries), with 28.6% (4 injuries) of injuries being contusions, and 14.3% (2 injuries) fractures. These injuries were to the knee in 28.6% (4 injuries) of the cases, and hip in 14.3% (2 injuries) of the cases. The rest of the injuries were distributed evenly about the body. Direct blows caused

50% (7 injuries) of these injuries, while overstretching caused 21.4% (3 injuries) and twisting forces caused 14.3% (2 injuries).

*Fullbacks* accounted for 11.5% (13 injured players) of all player injuries but 72.7% (8 fullbacks) of all fullbacks were injured. They accounted for 7.7% (1 injury) of all representative team injuries but 11.9% (12 injuries) of first division injuries. Fifty percent (4 injuries) of injuries to fullbacks were sprains. Contusions comprised 25% (2 injuries), strains and concussions without loss of consciousness 12.5% (1 injury) each. The knee and ankle each accounted for 25% (2 injuries) of the injuries. Twisting forces caused 50% (4 injuries) of the injuries, while a direct blow caused 37.5% (3 injuries) and overstraining caused 12.5% (1 injury). Figure 27 displays the general location of injuries for the three player groups.

These data supports findings by Clark and Roux(3), Roy(8), and Sugarman(18), that injuries occur evenly among forwards (51.1% of all injuries) and backs (49% of all injuries). It also compares to the literature in injury occurrence by specific position played. This study did show that a higher percentage of backs (69.9% of position injured) than forwards (61.9%).

**E) INJURIES BY CHANGE OF PLAYER POSITION**

Injuries happened to only 8.0% (9 players) of all players

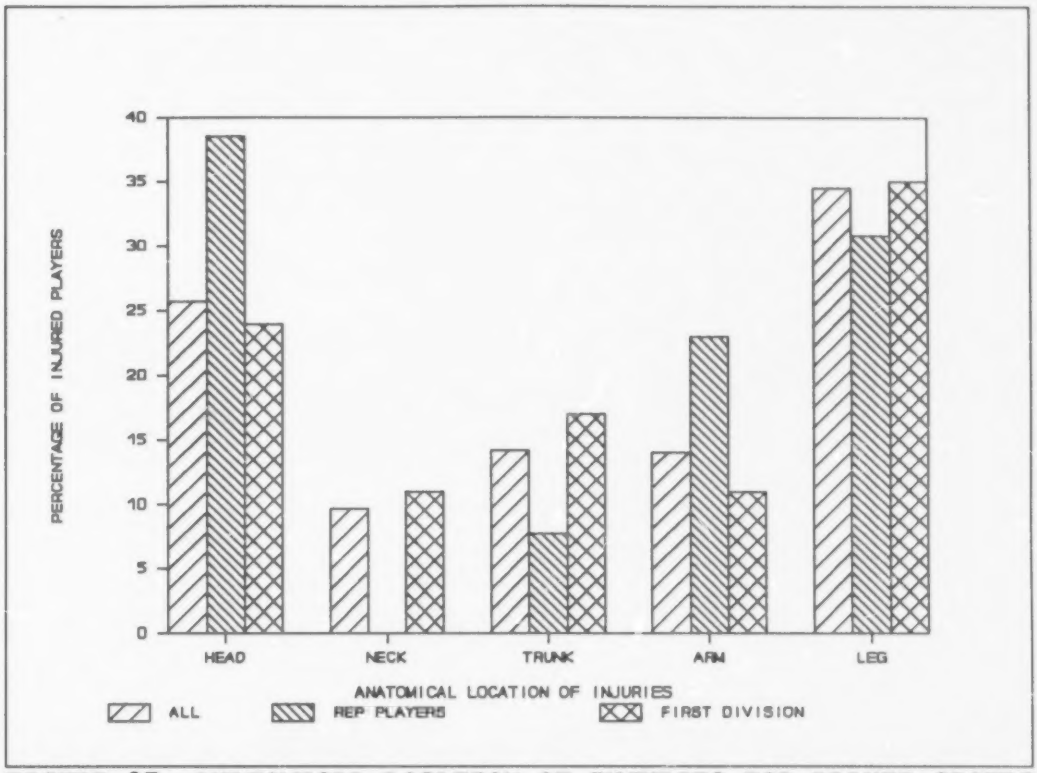



**FIGURE 27: ANATOMICAL LOCATION OF INJURIES FOR PLAYER GROUPS**

not playing their regular position. No representative team player was injured while playing another position and 9.0% of first division players were injured while playing another position. Thus it appears that changing position played is not a risk factor for injury. However, most players regularly play more than one position, allowing them to gain experience in other positions to provide for greater safety. It is unlikely that a representative player would be playing in a position unfamiliar to him.

## F) INJURIES WITH PRE-EXISTING INJURY

The majority of players injured did not have a history of the same injury previously (56.6% or 64 players), or have another pre-existing injury at the time of injury (77.0% or 87 players). Of those with a history of injury, 12.4% (14 players) had sustained the injury in the same season, and 24.8% (28 players) had sustained the injury in a previous season. Of those players injured, 22.1% (25 players) were playing with another injury. Figure 28 displays the data for reinjuries.

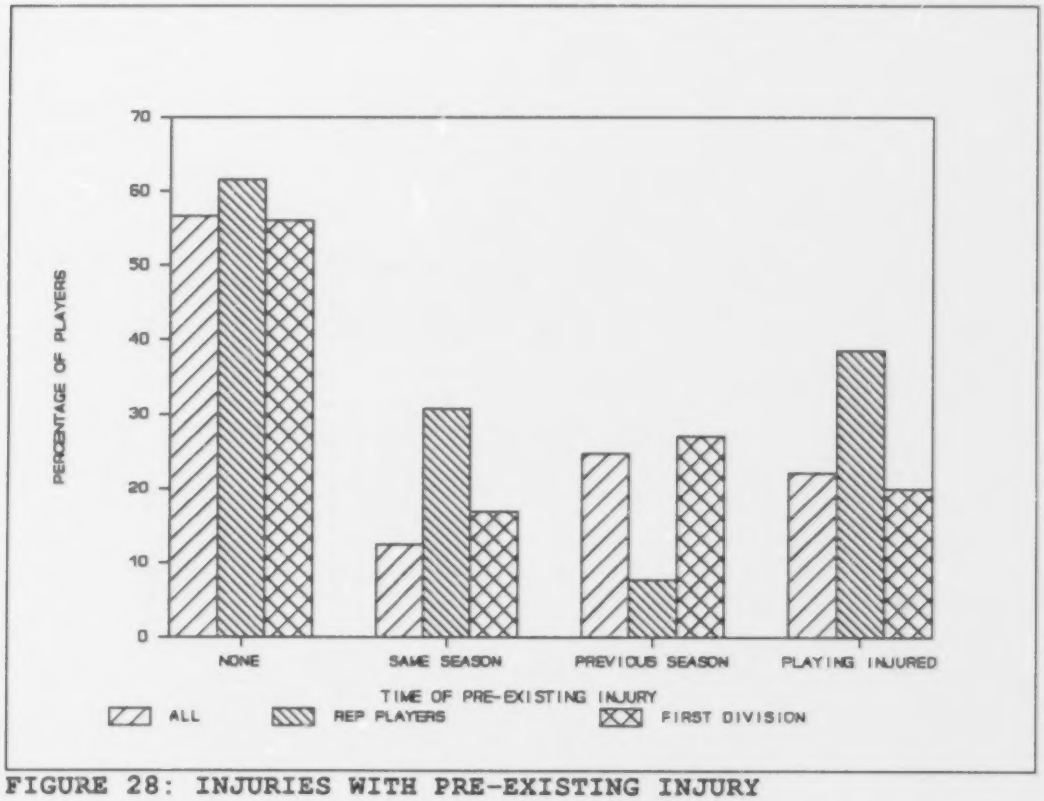



**FIGURE 28: INJURIES WITH PRE-EXISTING INJURY**

Of representative players injured, 30.8% (4 injuries)

were reinjuries from the same season, and 7.7% (1 injury) from a previous season, for an injury rate of 4.4 per 100 games for reinjured players (compared to 7.0 per 100 games for players not previously injured). Injured players playing with another injury at the time of injury comprised 38.5% (5 players) of representative players, for an injury rate of 4.4 per 100 games (compared to 7.7 for uninjured players).

Ten percent (10 players) of first division players were reinjured during the same season, and 27.0% (27 players) from a previous season, for an injury rate of 3.9 per 100 games for reinjured players (compared to 4.9 per 100 games for previously uninjured players). Twenty percent (20 players) were playing with an another injury at the time of injury, for an injury rate of 1.8 per 100 games (compared to 6.9 per 100 games for uninjured players).

The rates of injury were significantly different for $p \leq 0.05$ with a t-test between players with a previous or simultaneous injury versus players uninjured for total games played, with the uninjured players having the higher rates injury. Thus, pre-existing injury is not a risk factor for sustaining further injury.

**G) MOUTHGUARDS**

Mouthguard wearers constituted 58.6% (99 players) of the player population. Of players who sustained a head or facial injury, only 55.6% (10 players) were wearing mouthguards at

the time of injury. Forwards most commonly wore mouthguards with 92.3% (12 players) of hookers, 71.4% (15 players) of props, 68.4% (13 players) of second rows, 66.7% (18 players) of flankers and 45.5% (5 players) of number eights wearing a mouthguard regularly. Less than half of the backs wore mouthguards with 46.2% (6 players) of scrumhalves, 43.8% (7 players) of outside halves, 16.7% (3 players) of centres, 46.4% (13 players) of wingers and 50.0% (7 players) of fullbacks wearing them on a regular basis.

Level of skill was not a factor in wearing of mouthguards.

Players wearing mouthguards when sustaining a head or facial injury included second rows (40% or 4 players), flankers (10% or 1 player), outside halves (20% or 2 players), wingers (20% or 2 players), and fullbacks (10% or 1 player). Players not wearing mouthguards while sustaining the above injuries included second row (12.5% or 1 player), flanker (12.5% or 1 player), outside half (12.5% or 1 player), and centres (62.5% or 5 players). It is interesting to note that the position of centre is the least common wearer of a mouthguard and the most frequent recipient of head and facial injuries. Figures 29 and 30 illustrate the use of mouthguards for players sustaining head and face injuries.

Of the injuries sustained by mouthguard wearers, 40% (4 injuries) were lacerations, 50% (5 injuries) were concussions, and 10% (1 injury) were concussions with loss of

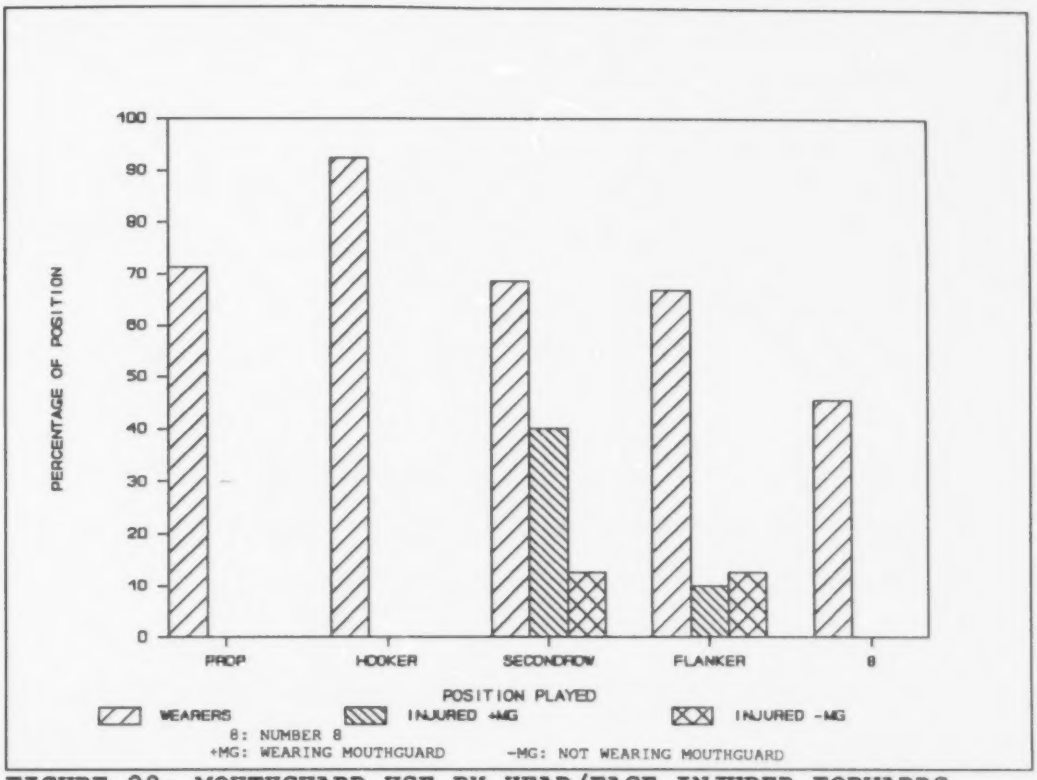



**FIGURE 29: MOUTHGUARD USE BY HEAD/FACE INJURED FORWARDS**

consciousness. Nonwearer injuries were 25% (2 injuries) lacerations, 37.5% (3 injuries) concussions and 37.5% (3 injuries) concussions with loss of consciousness. There were no dental injuries reported during this study. Thus, there were a total of 60% (6) concussions for mouthguard wearers and 75% (6) concussions with nonwearers, with a higher percentage of loss of consciousness for nonwearers. This was significant at a 0.22 level on a Chi Square test. Figure 31 illustrates the data for nature of head and face injuries with and without mouthguard use.

Head and face injuries were caused by direct blow 90% (9

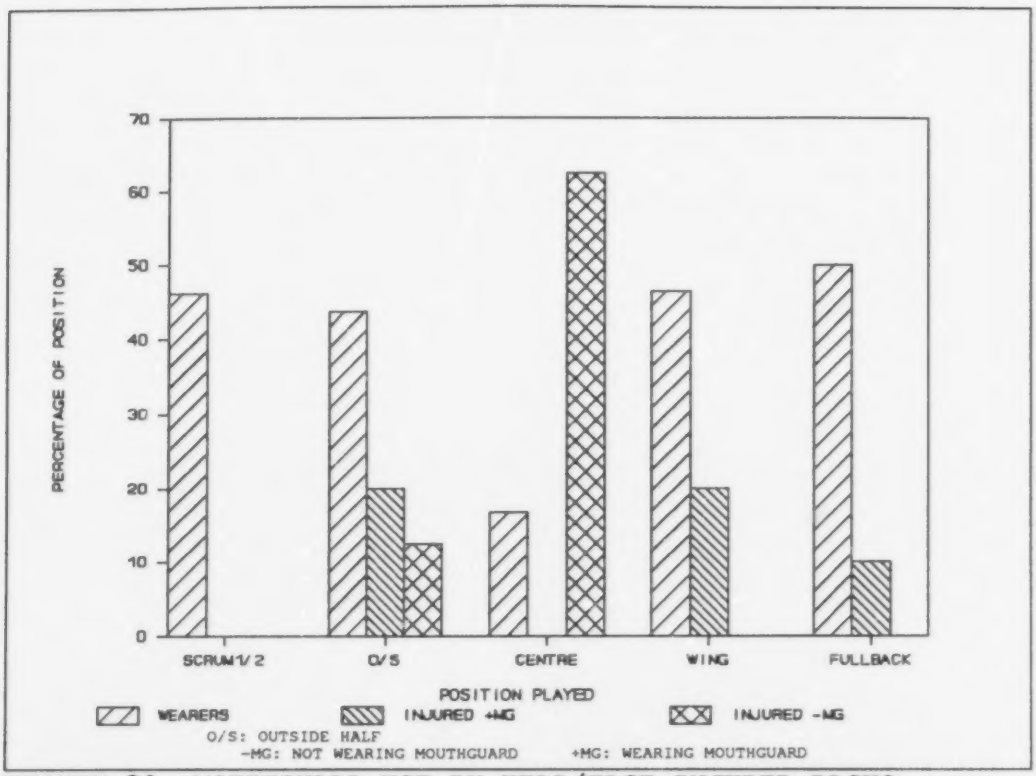



**FIGURE 30: MOUTHGUARD USE BY HEAD/FACE INJURED BACKS**

injuries) of the time for mouthguard wearers and 75% (6 injuries) of the time with nonwearers. Landing caused 10% (1 injury) of wearer head and face injuries and 12.5% (1 injury) nonwearer injuries. Compression force also caused 12.5% (1 injury) of nonwearer injuries. Thus it appears as though wearing of a mouthguard lessens injuries sustained from other than a direct blow. Figure 32 illustrates the cause of head and face injury data related to mouthguard use.

Mouthguard wearers sustained 50% (5 injuries) of their head and face injuries during rucks and mauls, and 30% (3 injuries) during tackling, while nonwearers had no injuries

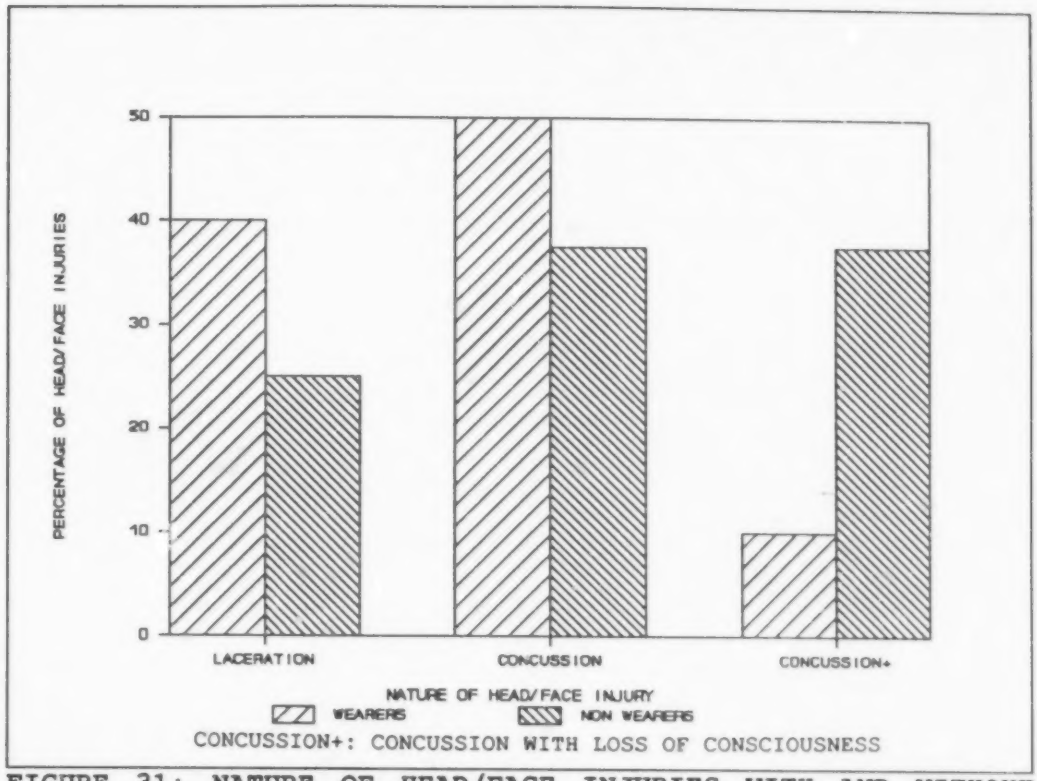



**FIGURE 31: NATURE OF HEAD/FACE INJURIES WITH AND WITHOUT MOUTHGUARD USE**

during these phases of play. Nonwearers sustained 75% (6 injuries) of their head and face injuries while being tackled compared to 10% (1 injury) of wearers. Wearers sustained 10% (1 injury) of their injuries during open play similar to nonwearers at 12.5% (1 injury), while nonwearers also sustained 12.5% (1 injury) of their injuries during collisions. Figure 33 displays these data.

Thirty percent (3 players) of wearers lost no playing time, 30% (3 players) returned to the same game, and 40% (4 players) were unable to continue playing. Only 12.5% (1 player) of nonwearers did not lose time, 37.5% (3 players)

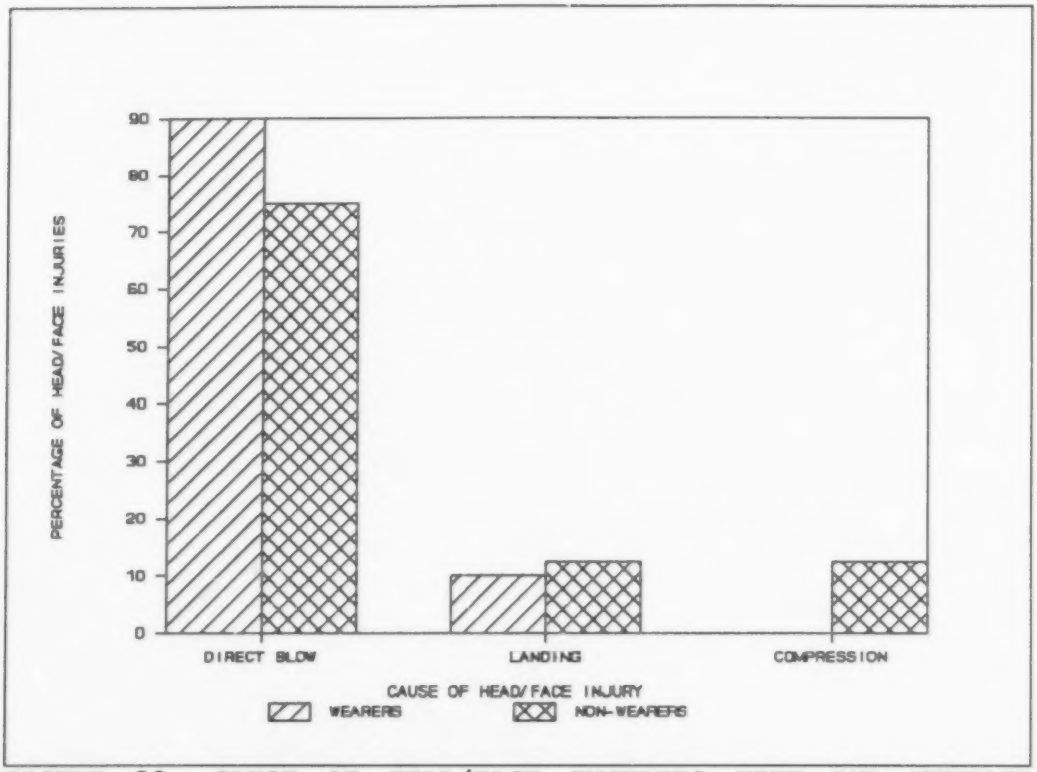



**FIGURE 32: CAUSE OF HEAD/FACE INJURIES WITH AND WITHOUT MOUTHGUARD USE**

returned to the same game, and 50% (4 players) were unable to continue playing. Thus, mouthguards decrease the amount of time lost from the game after injury with time lost from the game significant at the 0.22 level for mouthguard wearers and at 0.20 for nonwearers. Figure 34 displays the data for time lost from games due to head and face injuries related to mouthguard use.

Most mouthguard wearers (66.6% or 6 players) did not lose any future practice time, and 33.3% (3 players) lost one week or less, while 50% (4 players) of nonwearers lost one week or less. Most wearers did not miss any future games (55.6% or 5

players), with 33.3% (3 players) missing one week and 11.1% (1 player) missing two weeks of games. Nonwearers missed fewer games, with 25% (2 players) missing one week, and the rest (6 players) missing no future games. These data are a cause of concern, as it suggests that all of the players who lost consciousness due to concussion, returned to play one or two weeks after injury, which is less than the recommended time for recovery by physicians and the Canadian Rugby Union(45-47).

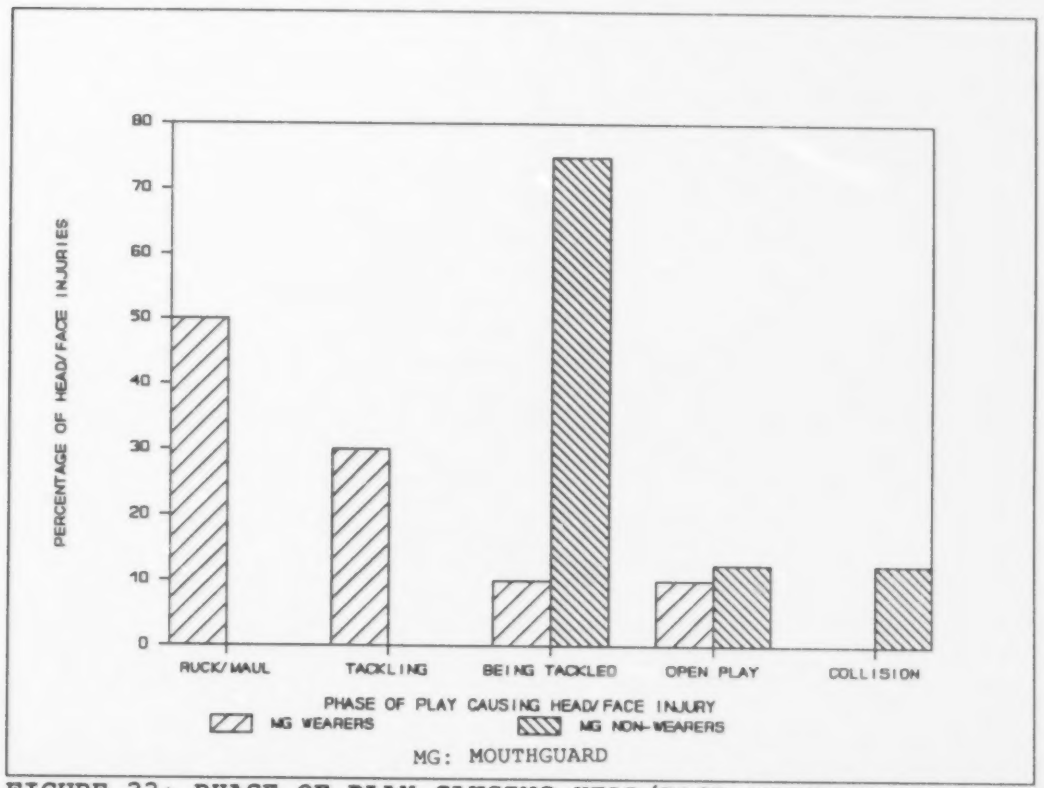



**FIGURE 33: PHASE OF PLAY CAUSING HEAD/FACE INJURIES WITH AND WITHOUT MOUTHGUARD USE**

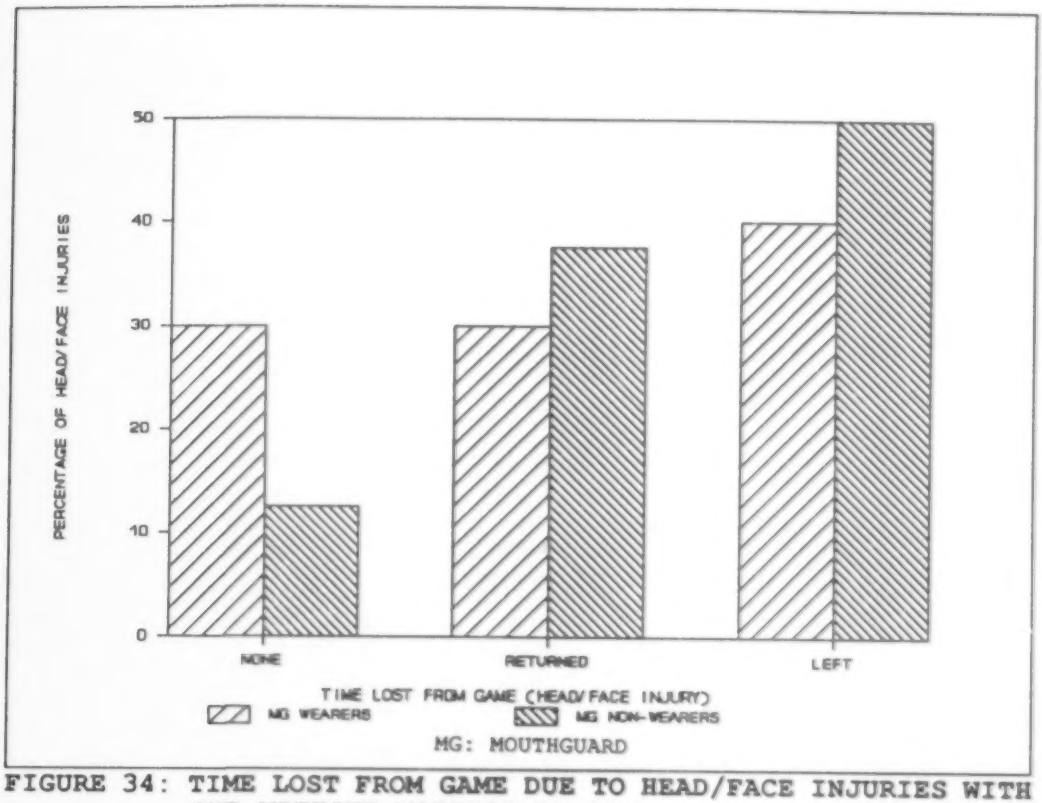



**FIGURE 34: TIME LOST FROM GAME DUE TO HEAD/FACE INJURIES WITH AND WITHOUT MOUTHGUARD USE**

**4) INJURIES BY FIELD CONDITION**

Of all injuries, 61.9% (70 injuries) were sustained on hard fields while 38.1% (43 injuries) were sustained on soft fields. Most injuries were sustained on smooth (84.8%), dry (80.4%), groomed (90.1%), grassy (97.3%) fields. However, most of the games were played under these conditions.

Chi Square tests were performed on field conditions versus time lost from future practices. Time lost from future practices was not found to be statistically significant for soft versus hard fields or dry versus wet fields. It was

**TABLE VI: PERCENTAGE OF FUTURE PRACTICES LOST DUE TO INJURIES OCCURRING ON VARIOUS FIELD CONDITIONS**

| TIME LOST | FIELD CONDITION DRY | WET |
|---|---|---|
| NONE | 19.7% | 7.0% |
| 1 WEEK OR LESS | 28.2% | 9.9% |
| 1 TO 4 WEEKS | 25.4% | 0.0% |
| 5 TO 12 WEEKS | 2.8% | 1.4% |
| MORE THAN 3 MONTHS | 4.2% | 1.4% |

| TIME LOST | FIELD CONDITION SOFT/WET | SOFT/DRY | HARD/WET | HARD/DRY |
|---|---|---|---|---|
| NONE | 5.6% | 5.6% | 1.4% | 13.9% |
| 1 WEEK OR LESS | 9.7% | 4.2% | 0.0% | 25.0% |
| 1-4 WEEKS | 0.0% | 12.5% | 0.0% | 12.5% |
| 5-12 WEEKS | 1.4% | 0.0% | 0.0% | 2.8% |
| MORE THAN 3 MONTHS | 0.0% | 1.4% | 1.4% | 2.8% |

significant at $p \leq 0.05$ for hard and dry fields versus soft and wet, or soft and dry, or hard and wet. However, the number of games played under the various conditions was not included in the statistical analysis, thus the data do not reflect the true field condition risk factor. Table VI shows these data.

Time lost from future games was not statistically significant on Chi Square tests for soft versus hard fields. However, injuries sustained on dry versus wet fields was significant at $p \leq 0.01$ with more time lost after injuries on dry fields. See Table VII for these data. Future games lost

**TABLE VII: PERCENTAGE OF FUTURE GAMES LOST DUE TO INJURIES OCCURRING ON VARIOUS FIELD CONDITIONS**

| TIME LOST | FIELD CONDITION DRY | WET |
|---|---|---|
| NONE | 31.9% | 4.2% |
| 1 WEEK OR LESS | 15.3% | 12.5% |
| 1-4 WEEKS | 26.4% | 0.0% |
| 5-12 WEEKS | 4.2% | 1.4% |
| MORE THAN 3 MONTHS | 2.8% | 1.4% |

| TIME LOST | FIELD CONDITION SOFT/WET | SOFT/DRY | HARD/WET | HARD/DRY |
|---|---|---|---|---|
| NONE | 4.2% | 6.9% | 0.0% | 25.0% |
| 1 WEEK OR LESS | 11.1% | 4.2% | 1.4% | 11.1% |
| 1-4 WEEKS | 0.0% | 11.1% | 0.0% | 15.3% |
| 5-12 WEEKS | 1.4% | 1.4% | 0.0% | 2.8% |
| MORE THAN 3 MONTHS | 0.0% | 0.0% | 1.4% | 2.8% |

were also statistically significant for hard and dry fields compared to soft and wet, or soft and dry, or hard and wet, at $p \leq 0.01$. These data are also displayed in Table VII.

## 5) INJURED VERSUS NON-INJURED PLAYER PROFILE

### A) AGE, HEIGHT AND WEIGHT

Non-paired Students t-tests were performed on the ages, weights, and heights of the injured and non-injured players. The mean age for injured players was 25.55 years with a standard deviation of 4.8, while the mean age of non-injured players was 26.02 years with a standard deviation of 4.5.

The mean height for injured players was 71.22 inches with a standard deviation of 3.1, similar to the mean height for non-injured players at 71.05 inches with a standard deviation of 3.1. The mean weight for injured players was 191.65 pounds with a standard deviation of 28.04, and the mean weight of the non-injured players was 188.63 pounds with a standard deviation of 21.29.

There were no statistically significant differences in these parameters for all players, or for the senior representative players. These parameters have not been analyzed in the literature reviewed.

**B) POSITION PLAYED**

There was no significant difference between forwards (54.2% injured) and backs (61.7% injured) for all players combined. There was a significant difference between injured and non-injured forwards and backs, significant at $p \leq 0.1$, for first division versus representative team players. These data are shown in Table VIII.

**TABLE VIII: COMPARISON OF INJURED FORWARDS AND BACKS FOR REPRESENTATIVE AND FIRST DIVISION PLAYERS**

| | PERCENTAGE OF INJURED PLAYERS | | | |
|---|---|---|---|---|
| | REP PLAYERS | | FIRST DIVISION | |
| | FORWARDS | BACKS | FORWARDS | BACKS |
| INJURED PLAYERS | 31.3% | 33.3% | 61.4% | 68.1% |

A Chi Square test was performed on injured and non-injured players by position played and there was no significant difference between injured and non-injured players for position. Some of the literature reviewed shows that forwards have a greater rate of injuries than backs(2,11,19), while some(8,16-18) found a similar rate of injury between forwards and backs.

**C) SKILL LEVEL**

Chi Square tests were performed on the injured and non-injured players by skill level (first division or representative team). There was a significant difference between first division (64.4% injured) and representative team (32.1% injured) with $p \leq 0.005$. Table IX displays these data. This finding is not in agreement with the findings of Davies and Gibson(11) and Roy(8), that higher levels of competition result in a higher incidence of injury.

**TABLE IX: COMPARISON OF PERCENTAGE OF INJURED REPRESENTATIVE PLAYERS AND FIRST DIVISION PLAYERS**

| | PERCENTAGE OF INJURED PLAYERS | |
|---|---|---|
| | REP PLAYERS | FIRST DIVISION |
| INJURED PLAYERS | 32.1% | 64.4% |

**D) PRESEASON TRAINING**

A Chi Square test was performed on injured and non-injured players by taking into account preseason training. There was no significant difference for amount of preseason training at any skill level of play. It is notable that, 100% of players with no preseason training were injured. All representative team players had participated in preseason training, and 68% of those with over one month preseason training remained uninjured. Table X displays these data. This parameter was not documented in the literature reviewed.

**TABLE X: PERCENTAGE OF INJURED PLAYERS BY PRESEASON TRAINING**

| PRESEASON TRAINING | PERCENTAGE INJURED PLAYERS | | |
|---|---|---|---|
| | ALL PLAYERS | FIRST DIVISION | REP PLAYERS |
| NONE | 100.0% | 100.0% | NO PLAYERS |
| ONE MONTH OR LESS | 57.1% | 63.6% | 33.3% |
| MORE THAN ONE MONTH | 56.9% | 63.7% | 32.0% |

## V) SUMMARY AND CONCLUSION

### PURPOSE OF THIS STUDY

The purpose of this study was to establish a baseline of data on player profiles, and incidence of injuries in Canadian Prairie (Alberta) rugby, including nature, location, severity (time lost), and cause of injuries, which occurred in a regular season of first division club play in Edmonton, and senior representative level of rugby union games. It tried to determine whether the injured players differed from the non-injured players in age, height, weight, skill level, position played, or level of preseason training.

The study described the occurrence of injuries according to the month of play, when in the game, phase of play, ball possession, change of position played, players playing with previous or simultaneous injuries, or according to various field conditions.

Based on the findings of this study, the following conclusions can be made:

1. The rate of injury in the year studied (1989) for first division player appearances was 8.86% and 11.44% for representative team player appearances. The most common cause of injury was a direct blow. Other causes in order of frequency were rotation forces, overstretching, and compression forces. There were four different causes of injury for representative players while there were eight

different causes for first division players, as described in the results section.

2. Sprains were the most common nature of injury, followed by contusions, lacerations and strains. The most common location of injury was the head, followed by the knee and ankle.

3. Injuries incurred were of a minor nature as more than half (63.1%) of the injured players completed the game after injury. Most injured players (57.2%) lost one to two weeks of future practice time, 28.2% lost no future practice time, 43.2% missed no future games, and 41.4% lost one or two weeks of future games.

4. Injuries peaked in mid-season (July) and during the second and fourth quarters of the game.

5. Cervical spine injuries were low (9.6% of all injuries), and were most frequent in flankers and centres, followed by outside halves. They were caused most frequently by a direct blow or overstretching, followed by rotation and compression forces. They occurred mainly during rucks and mauls (45.5%), and also during tackling and being tackled (27.3% each). Set scrummaging was not a cause of cervical spine injuries. Most of these injuries occurred during the fourth quarter (45%) or second half (72.8%) of the game, while 18.2% occurred in the first quarter of the game. These injuries were not usually serious as only 27.3% of the injured

players did not return to the game, and 72.7% did not miss any future games.

6. Being tackled was the leading phase of play causing injury accounting for 25.7% of all injuries. Representative players had seven causes of injury with 53.8% due to being tackled. First division players had fourteen causes of injury with rucks/mauls causing 25% and being tackled causing 22%.

7. The ball was involved during play in 80.7% of all injuries. Thus, as only the ball carrier is supposed to be tackled, most injuries were not from late or illegal tackles.

8. Injuries occurred evenly among forwards and backs. Most of the injuries occurred to flankers (14.9%), followed closely by centres, second rows, props and wingers. The position having the greatest percentage of injuries was centre (84.2%), followed by second row, fullback, and winger.

9. Change of player position was not a risk factor for injury as only 8.0% of all players not playing their regular position were injured.

10. Playing with a pre-existing injury was not a risk factor for injury in this study, as only 43.4% of injured players had a history of the same injury previously, and only 33.0% were playing with a pre-existing injury.

11. Forwards most commonly wore mouthguards. Centres were the least common wearer of mouthguards and the most frequent recipient of head and facial injuries. More concussions and loss of consciousness were suffered by

nonwearers than wearers of mouthguards. Mouthguard wearers had less head and facial injuries due to causes other than a direct blow. Wearers of mouthguards lost less time from play during the game and from future practices. Nonwearers missed fewer future games, despite their higher rates of concussion and loss of consciousness.

12. Injuries sustained on dry fields caused significantly more loss of time than injuries sustained on wet fields. Injuries sustained on dry fields resulted in 60.6% of the time lost from future practices and 48.7% of the time lost from future games, while injuries sustained on wet fields resulted in 12.7% of the time lost from future practices and 15.3% of the time lost from future games. Significantly more future games and practices were lost following injuries sustained on hard and dry fields (43.1% of future practices and 32.0% of future games lost) compared to soft and wet (11.1% of future practices and 12.5% of future games), or soft and dry (18.1% of future practices and 16.7% of future games), or hard and wet fields (1.4% of future practices and 2.8% of future games). However, most of the games were played on hard, dry surfaces and this was not adjusted for in the analysis of these data.

13. There were no significant differences between injured and noninjured players in profile, position played, or preseason training.

14. There was a significant difference between injured and noninjured players in skill level, with the first division players sustaining more injuries than the representative team players.

## VI) RECOMMENDATIONS

All involved with the sport of rugby are concerned about making the sport more safe. Based on the findings of this study, recommendations to increase the safety of rugby are as follows:

1. The most common cause of injury is a direct blow. This type of injury is inherent to the game of rugby and will not change. Other causes, such as twisting and rotation in scrummages, can be decreased by the referee stopping play more quickly in adverse conditions.

2. The high percentage of injuries due to tackling and being tackled shows that there is great need for increased training to improve the skills of proper tackling, eluding or receiving tackles, and falling(5,14,18,25,51). It has been recommended that the cervical spine be held in extension during dangerous plays such as these plays(35). The majority of rugby players in Edmonton come from sports backgrounds where they are used to wearing protective equipment, and often tackle with their heads(52), thus they need to be trained in these techniques even as adults.

3. More control is needed over rucks and mauls to improve safety during these activities. Perhaps limits to the number of players involved or the amount of time the play is allowed to carry on will help. Improved skill (such as body position, knowledge of the goals of rucks and mauls, and personal safety) by training for these plays during practice may help,

as well as better control of the play by the referees to decrease foul play or unnecessary roughness.

4. The use of mouthguards should be considered essential(9,16), especially for centres, to decrease severity of concussions. The Canadian Rugby Union has issued a directive to encourage all schoolboys to wear mouthguards.

5. Irrigation systems should be built into all new pitches to provide softer playing surfaces. Since injuries were less severe on hard, wet surfaces, perhaps existing pitches could be sprayed with water prior to games.

Based on information gathered in this study, the following are recommendations for further study:

1. An investigation into whether strengthening of all spinal musculature, especially for props and hookers, would decrease spinal injuries caused during scrummaging would be of value.

2. It would be beneficial to study the value of the second row and number 8 players wearing soft padded headgear, such as a scrum cap to decrease head and facial injuries.

3. It would be of value to study the benefit of preventative ankle taping in reducing ankle injuries, especially for flankers and fullbacks, and thumb taping for scrumhalves.

4. A thorough investigation into fitness levels of players would be of value to determine if increased fitness levels would decrease injuries due to fatigue (perhaps the

reason for midseason, second and fourth quarter of the game injury peaks).

5. An investigation into the benefit of strength, flexibility, fitness and proper warm-up in preventing injuries induced by running would be of value, especially for prevention of knee injuries for wingers and fullbacks.

6. An investigation into the value of proper rehabilitation for injuries to prevent reinjury would be of value.

7. It would be of value to study various scrummaging techniques such as having the front rows pack separately, then sequentially adding on the other rows(48,50), or having the props place their outside arm on their thigh rather than bind to their opposite player(38,48) to decrease the initial impact(22,47,48,50), to determine if they decrease injuries due to scrummaging.

8. It would be of value to study the different types of boots (inflexible sole with aluminum studs, soft rubber soles with many short rubber cleats) to determine if a change in footwear would lessen the number of lacerations and knee injuries received.

9. It would be useful to report risks from individual player perspectives.

10. Causal modeling of risk factors might provide information on the nature of multiple casuality and mediating factors.

## BIBLIOGRAPHY


1) Micheli LJ, Risebrough EM: The Incidence of Injuries in Rugby Football. J Sp Med 2(2): 93-8, 1974.

2) Addley K, Farren J: Irish Rugby Injury Survey: Dungannon Football Club (1986-7). Br J Sports Med 22(1): 22-4, 1988.

3) Clark DR, Roux C, Noakes TD: A Prospective study of the incidence and nature of injuries to adult rugby players. SA Med J 77(11): 559-62, 1990.

4) Currier DP: Elements of Research in Physical Therapy 2nd ed. Baltimore: Williams and Wilkins, 1984.

5) Murphy W, Shuttleworth J: Risk Factors in Rugby Union Football. Brit J Sports Med 12(1): 48-50, 1978.

6) MacLeod DAD, Pattison PH: The need to make rugby safer (letter). Br Med J 296(6620): 498-9, 1988.

7) O'Connell TC: Rugby Football Injuries and Their Prevention. J Irish Med Assoc 34: 20-6, 1954.

8) Roy SP: The Nature and Frequency of Rugby Injuries. SA Med J 48(56): 2321-7, 1974.

9) Myers PT: Injuries Presenting From Rugby Union Football. Med J Aust 2: 17-20, 1980.

10) Blignault JB, Carstens IL, Lombard CJ: Injuries Sustained in Rugby by Wearers and Non-wearers of Mouthguards. Brit J Sports Med 21(2): 5-7, 1987.

11) Davies JE, Gibson T: Injuries in Rugby Union Football. Br Med J 23(30): 1759-61, 1978.

12) Inglis GS, Stewart ID: Rugby Injury Survey 1979. NZ Med J 94: 349-50, 1981.

13) MacEwen CJ: Sport associated eye injury: a casualty department survey. Br J Opthamol 71(9): 701-5, 1987.

14) Walkden L: The Medical Hazards of Rugby Football. Pract 215: 201-7, 1975.

15) Williams P, McKibbon B: Unstable cervical spine injuries in rugby - a 20 year review. Injury 18(5):329-332, 1987.

16) Nathan M, Goedeke R, Noakes TD: The Incidence and Nature of Rugby Injuries Experienced at One School During the 1982 Rugby Season. S Afr Med J 64: 132-7, 1983.

17) Roux CE, Goedeke R, Visser GR et al: The epidemiology of schoolboy rugby injuries. SAMJ 71(7): 307-13, 1987.

18) Sugarman S: Injuries in an Australian Schools Rugby Union Season. Aust J Sports Med and Ex Sci 15(1): 1-10, 1983.

19) Reilly T, Hardiker H: Somatotype and injuries in adult student rugby football. J Sports Med 21: 186-91, 1981.

20) Adams ID: Rugby Football Injuries. Br J Sp Med 11:4-6, 1977.

21) Archibald R: An Analysis of Rugby Football Injuries in the 1961-62 Season. The Practitioner 189: 333-4, 1962.

22) Burry HC, Calcinai CL: The need to make rugby safer. Br Med J 296(6616): 149-50, 1988.

23) Durkin TE: A Survey of Injuries in a First Class Rugby Union Football Club from 1972-76. Br J Sp Med 11: 7-11, 1977.

24) Jones DG: The need to make rugby safer (letter). Br Med J 296(6623): 429, 1988.

25) Silver JR, Gill S: Injuries of the spine sustained during rugby. Sports Med 5: 328-334, 1988.

26) Sparks, JP: Half a Million Hours of Rugby Football. Br J Sp Med 15(1): 30-2, 1981.

27) Scher AT: Premature onset of degenerative disease of the cervical spine in rugby players. SA Med J 77: 557-558, 1990.

28) Scher AT: Rugby injuries to the cervical spinal cord. SA Med J 51: 473-475, 1977.

29) Chapman PJ: The prevalence of orofacial injuries and use of mouthguards in Rugby Union. Aust Dent J 30(5): 364-7, 1985.

30) Hawke JE: Dental Injuries in Rugby Football. NZ Dent J 65: 173-5, 1969.

31) Badley WD: Rugby Football Injuries in Canada. Canadian Rugby Union Safety Committee Report, 1989.

32) Garvie JL: Rugby Injuries. CPA Sports Physiotherapy Division Newsletter 11(6): 26-9, 1987.

33) Nigg BM, Segesser B: The Influence of Playing Surfaces on the Load on the Locomotor System and on Football and Tennis Injuries. Sports Med 5: 375-85, 1988.

34) Taunton JE, McKenzie DC, Clement DB: The role of biomechanics in the Epidemiology of injuries. Sports Med 6: 107-120, 1988.

35) Scher AT: Vertex impact and cervical dislocation in rugby players. SA Med J 59: 227-228, 1981.

36) Scher AT: Serious cervical spine injury in the older rugby player. SA Med J 64: 138-140, 1983.

37) Scher AT: Cervical vertebral dislocation in a rugby player with congenital vertebral fusion. Br J Sp Med 24(3): 167-168, 1990.

38) Milburn PD: A comparison of the mechanics of hip and crotch binding technique in rugby union scrummaging. Austr J Science and Med Sport 19(1): 3-9, 1987.

39) Chapman PJ: Players' attitudes to mouthguards and prevalence of orofacial injuries in the 1987 U.S. rugby football team. Am J Sports Med 17(5): 690-691, 1989.

40) Chapman PJ: The pattern of use of mouthguards in rugby league (A study of the use of the 1986 Australian Rugby League touring team). Br J Sports Med 22(3): 98-100, 1988.

41) Jennings DC: Injuries sustained by users and non-users of gum shields in local rugby union. Br J Sports Med 24(3): 159-165, 1990.

42) Kay EJ, Kakarla P, Macleod DAD, McGlashan TPL: Orofacial and dental injuries in club rugby union players. Br J Sports Med 24(4): 271-273, 1990.

43) Fletcher RH, Fletcher SW, Wagner EH: Clinical Epidemiology: the essentials 2nd ed. Baltimore: Williams and Wilkins, 1988.

44) Jardine MA, Wiggins TM, Myburgh KH, Noakes TD: Physiological characteristics of rugby players including muscle glycogen content and muscle fibre composition. SA Med J 73:529-532, 1988.

45) DePodesta M: A practical and effective approach in dealing with emergency situations. CATA Journal, Fall:5-8, 1982.

46) British Columbia Medical Association: Medical considerations for playing sports (Brochure). Vancouver, BC.

47) International Rugby Union: International Rules of Rugby.

48) Milburn PD: The kinetics of rugby union scrummaging. J Sports Sciences 8: 47-60, 1990.

49) McLean DA: Role of the team physiotherapist in rugby union football. Br J Sports Med 24(1): 19-24, 1990.

50) Taylor TKF, Coolican MRJ: Rugby must be safer: Preventative programmes and rule changes. Med J Australia 149(4): 224, 1988.

51) Piggot J: The need to make rugby safer. Br Med J 296: 1260, 1988.

52) Torg JS, Vegso JJ, O'Neill MJ, Sennett B: The epidemiologic, pathologic, biomechanical and cinematographic analysis of football-induced cervical spine trauma. Am J Sports Med 18(1): 50-57, 1990.

53) Krathwohl DR: How to Prepare a Research Proposal. Syracuse: Syracuse University Bookstore, 1965.

54) Norman S: PDQ Statistics. Toronto: BC Decker Inc, 1986.

55) Oyster CK, Hanten WP, Llorens LA: Introduction to Research: A Guide for the Health Science Professional. Philadelphia: JB Lippincott Co., 1987.

**APPENDIX A**

**EDMONTON RUGBY UNION INJURY REPORT FORM** **DATE**_____

**1) PLAYER DATA**

NAME_____AGE_____HEIGHT_____WEIGHT_____

TEAM_____DIVISION_____POSITION_____

PLAYERS REGULAR POSITION:SAME_____ OTHER_____

MOUTHGUARD_____YES _____NO NUMBER OF PLAYERS THIS GAME_____

**2) PRESEASON TRAINING:**

_____NONE _____1 MONTH OR LESS _____ MORE THAN 1 MONTH

TYPE OF TRAINING:____RUNNING ____OTHER AEROBIC (SWIMMING, CYCLING)

_____WEIGHT TRAINING _____OTHER SPORT _____OTHER

**3) NATURE OF INJURY**

__SPRAIN (JOINT) ___STRAIN (MUSCLE) __BRUISE ___LACERATION/ABRASION

___FRACTURE ___DISLOCATION ___SUBLUXATION

___SPINE RADICULAR SIGNS: ___PRESENT ___ABSENT

___CONCUSSION ___LOSS OF CONSCIOUSNESS __NO LOSS OF CONSCIOUSNESS

OTHER:_____

**4) LOCATION OF INJURY**

___HEAD ___FACE ___EYE ___EAR ___NOSE ___TOOTH ___JAW

___NECK ___CHEST ___RIBS ___ABDOMEN ___BACK ___GROIN

___SHOULDER ___AC JOINT ___UPPER ARM ___ELBOW ___LOWER ARM

___WRIST ___HAND ___FINGER ___THUMB

___HIP ___FRONT OF THIGH ___BACK OF THIGH ___SIDE OF THIGH ___KNEE

___SHIN ___CALF ___ANKLE ___FOOT ___TOE SPECIFY:_____

**5) CAUSE OF INJURY**

___DIRECT BLOW ___TWISTING/ROTATION FORCE ___COMPRESSION FORCE

___OVERSTRETCHED ___OVERSTRAINED ___TRIP/FALL ___LANDING

___OTHER:_____

BALL POSSESSION ___YES ___NO

WAS THIS A REINJURY? ___YES ___NO ___THIS SEASON ___PREVIOUS SEASON

WAS HE HAVE ANOTHER INJURY AT THE TIME OF THIS INJURY?___YES ___NO

REINJURY OR OTHER INJURY FROM:___GAME ___PRACTICE OTHER:_____

**6) PHASE OF PLAY**

___SCRUM: ___ENGAGING ___DRIVING ___COLLAPSING ___OTHER

___RUCK/MAUL: ___ENGAGING ___DRIVING ___COLLAPSING ___OTHER

___LINE OUT ___TACKLING ___BEING TACKLED ___RUNNING ___COLLISION

___OPEN PLAY ___OTHER_____

**7) TIME OF INJURY** (QUARTER)

___FIRST ___SECOND ___THIRD ___FOURTH ___OVERTIME ___WARM-UP

**8) TIME LOST FROM PLAY**

___NONE ___RETURNED TO SAME GAME ___DID NOT COMPLETE GAME

CODE FOR TIME LOST: MISSED PRACTICE ONLY: P MISSED GAMES ONLY: G
MISSED PRACTICE AND GAMES: PG

___ONE WEEK ___TWO WEEKS ___THREE WEEKS ___FOUR WEEKS

___4-6 WEEKS ___6-8 WEEKS ___8-10 WEEKS ___10-12 WEEKS

___MORE THAN 3 MONTHS ___REST OF SEASON

**9) LOCATION OF GAME**

___ELLERSLIE RUGBY UNION ___LEDUC ___ST. ALBERT RUGBY UNION
___RED DEER ___CALGARY RUGBY UNION (KINGSLAND) OTHER_____

**10) FIELD CONDITION AT SITE OF INJURY**

| | | | |
|---|---|---|---|
| ___SOFT | ___HARD | ___FROZEN | ___DEEP RUTS |
| ___SMOOTH | ___UNEVEN | ___GROOMED | ___POOR |
| ___DRY | ___WET | ___MUDDY | ___PUDDLES |
| ___GRASS | ___DIRT | ___DEBRIS | _____OTHER |

**11) DID THE FIELD CONDITION AFFECT THIS INJURY?** __YES __NO __NOTSURE
IF YES, HOW? ____CAUSED ____INCREASED ____DECREASED

**12) OUTCOME OF THIS GAME:** ___WON ___LOST ___TIED

APPENDIX B

Rugby

May 5, 1989

**Leigh Garvie**
**10119 - 84 Avenue**
**Edmonton, Alberta**
**T6E 2G8**

Dear Leigh;

I have read with interest your study proposal and believe that it will be useful for prevention of injuries. The Edmonton Rugby Union endorses your study and requests the cooperaton of all member clubs, officials and executive members.

We regret that we cannot fund the study, but would like to offer administrative services such as mail-outs and photocopies.

Good luck with your study.

Yours truly,

Laura G. Jackson,
President

**EDMONTON RUGBY UNION**

ELLERSLIE RUGBY PARK SITE 1, RR# 3 SOUTH EDMONTON, ALBERTA T6H 4N7 TELEPHONE 988 5245

## APPENDIX C
## STATISTICAL FORMULAE

ANALYSIS

INCIDENCE OF INJURY $\frac{\text{total number of injuries}}{\text{total number of games}}$

INCIDENCE OF INJURY $\frac{\text{total number of injuries in month}}{\text{total number of games in month}}$

RATE OF INJURY $\frac{\text{total injuries}}{\text{total player appearances}}$

FREQUENCY OF INJURIES PER POSITION (PERCENTAGE) $\frac{\text{total position injuries}}{\text{total injuries}}$

FREQUENCY OF TYPE OF INJURY (PERCENTAGE) $\frac{\text{number of specific injury}}{\text{total injuries}}$

TYPE OF INJURY PER POSITION $\frac{\text{number of type of injury}}{\text{total position injuries}}$

RISK FACTORS

RATE OF INJURIES VS FIELD CONDITION

$$\frac{\frac{\text{number of injuries on wet fields}}{\text{total players in games on wet fields}}}{\text{VS}} \quad \frac{\text{number of injuries on dry fields}}{\text{total players in games on dry fields}}$$

NATURE OF INJURIES VS FIELD CONDITIONS

$$\frac{\text{total sprains on wet fields}}{\text{total players on wet fields}} \quad \text{VS} \quad \frac{\text{total sprains on dry fields}}{\text{total players on dry fields}}$$

RELATIONSHIP OF TIME LOST TO FIELD CONDITION

| | WET/SOFT% | DRY/HARD% |
|---|---|---|
| Less than one week | | |
| 1 week to 1 month | | |
| 1 month to 3 months | | |
| More than 3 months | | |

## APPENDIX D
## GUIDELINES TO COMPLETION OF EDMONTON RUGBY INJURIES QUESTIONNAIRE

### INTRODUCTION

The definitions in this guide are accurate descriptions of injuries are intended solely to assist in the completion of the above named questionnaire. Definitions are not complete and should not be considered a definitive basis for injury diagnosis.

Any serious injury should be referred for medical diagnosis and treatment.

Any publication of data collected in this study will maintain the anonymity of the participants.

Valid data require accurate completion of the questionnaires. If you have any questions regarding the completion, please contact the researcher at the numbers below.

**INJURIES RECORDED WILL BE ANY INJURY SEVERE ENOUGH TO CAUSE AT LEAST A TEMPORARY INTERRUPTION OF A PLAYERS' CONTRIBUTION TO A GAME OR IMPAIR HIS SUBSEQUENT ABILITY TO TRAIN OR PLAY, OR REQUIRE MEDICAL INTERVENTION.**

All definitions have been based on those found in the following references:

B.C. SPORTS AID PROGRAM: TAPING. Ministry of Provincial Secretary and Government Services, British Columbia.

Magee DM: Orthopaedics: Conditions, Assessment and Treatment Vol 1. University of Alberta Press, Edmonton 1982.

Magee DM: Sports Physiotherapy. University of Alberta Press, Edmonton 1988.

Reid DC: Assessment and Treatment of the Injured Athlete. University of Alberta Press, Edmonton 1985.

Thank you for your participation in this study.

Leigh Garvie
(H): 433-3029
(W): 454-0374

## SECTION 1: PLAYER DATA

Please fill this section out completely prior to returning the forms.

This information will be used in the study and in case the player needs to be contacted regarding other information on the form.

Please include the month and the date (ie. May 13) for the date.

**"NUMBER OF PLAYERS THIS GAME"** refers to the total number of players on the injured player's team who played any part of the game (ie. late comers, substitutes).

## SECTION 2: PRESEASON TRAINING

Please indicate the player's **REGULAR** form of training.

**RUNNING**: any regular running activity

**OTHER AEROBIC**: includes any continuous type of exercise lasting 20 minutes or longer (swimming, cycling, fitness class)

**WEIGHT TRAINING**: includes any form of resistance training

**OTHER SPORT**: includes participation in any regular team or individual sporting activity

## SECTION 3: NATURE OF INJURY

**DEFINITIONS**:

**SPRAIN** - any injury to a ligament or joint

Signs and Symptoms may include:

- mild to severe swelling and bruising
- pain at end of range of movement only or pain through range of motion
- limitation of range of motion
- pain to palpation
- pain to stress
- laxity or abnormal joint movement to stress
- no loss of strength to significant loss of strength
- pain with function (ex. walking, running) that may limit function
- muscle spasm
- may have heard a "snap" or "pop"

**STRAIN** - any injury to a muscle, its tendon, and/or its attachment

Signs and Symptoms may include:
- mild to severe swelling, bruising, haematoma (lump), or deformity
- mild to severe muscle spasm
- local pain at end of range of movement, to severe pain that limits movement
- minimal strength loss with pain to resisted movement, to significant strength loss
- pain to palpation to local or general area

**BRUISE** - any injury to tissues without breaking the skin
-it can include damage to skin, bone, muscle, tendon, nerves, or blood vessels.

Signs and Symptoms may include:
- no swelling to extensive swelling
- no discolouration to extensive discoloration
- minimal loss of strength to significant loss of strength
- local pain and tenderness with or without movement, to severe pain and muscle spasm which limits movement and muscle contraction
- complaints of stiffness

**LACERATION** - any tearing or cutting of the soft tissues

**ABRASION** - any skin wound caused by rubbing or scraping ^A
- ie. "raspberries", field burns, large areas of scabbing

**FRACTURE** - any break in the continuity of a bone
- there may or may not be a wound extending to the surface (ie. a break in the skin)

**DISLOCATION** - a displacement of one bone apart from its relationship with another at a joint so that there is no contact of the normal joint surfaces
- there may or may not be an open wound

**SUBLUXATION** - a partial dislocation where there is partial contact of the joint surfaces
- it may have reduced spontaneously or by the athlete

**SPINE** - include all injuries involving the vertebral column
- do not include minor sprains and strains of spinal soft tissues (classify these as sprains, strains of neck etc)

**RADICULAR SIGNS** - these are present if there are any abnormal neurological signs such as:

- pain radiating down the arm, leg or around the trunk
- numbness, tingling or any abnormal sensation as a result of the injury
- weakness of any muscle as a result of the injury
- any change in reflexes as a result of the injury

**CONCUSSION** - any injury which results in an interruption of brain activity which is not associated with evidence of permanent damage to the brain

Signs and Symptoms may include:

- no or temporary loss of consciousness
- mental confusion, temporary or long term loss of memory
- dizziness or unsteadiness
- change in pupils or loss of normal eye movement
- temporary blurring of vision
- headache, ringing in ears, slurred speech, nausea
- possible convulsions, seizures, abnormal breathing

## SECTION 4: LOCATION OF INJURY

Check off the appropriate location of the injury on the player's body.

For more specific locations please complete the "specify" space.

Example: __X__ FACE SPECIFY: cheek

## SECTION 5: CAUSE OF INJURY

Check off the cause of the injury as you and the player can best describe.

Complete "other" if you cannot find a term which you feel describes the cause of the injury.

**BALL POSSESSION** - indicate whether the ball was involved with the play that caused the injury (ie. either the player injured or the player causing the injury had possession of ball when tackle was initiated, or was passing or catching the ball at time of injury). The ball is involved in scrums, rucks, mauls and lineouts.

**REINJURY** - this is a reinjury if this is not the first time this exact injury has occurred to the player (same injury, same location).

**SUFFERING FROM ANOTHER INJURY** - indicate if the player had any pre-existing injury of any type at the time of this injury.

## SECTION 6: PHASE OF PLAY

Check off what the injured player was involved in at the time of his injury.

**SCRUMS, RUCKS AND MAULS:** indicate what was happening at the time of injury

## SECTION 7: TIME OF INJURY

Check off the time during the game that the injury occurred in.

## SECTION 8: TIME LOST FROM PLAY

**NONE** - if the player continued play when play resumed, never leaving the pitch

**RETURNED TO SAME GAME** - if the player left the pitch for further assessment or medical attention (steri-strips of wound, taping etc) while play continued without him, and he returned to the game to continue playing.

**DID NOT COMPLETE GAME** - the player left the pitch and did not play in the game to it's completion, whether or not there was a substitute for him, or he attempted to return to play unsuccessfully.

**TIME LOST** - use "P" to indicate the length of time the player was unable to participate in practices due to the injury.
- use "G" to indicate the length of time the player was unable to play in games due to the injury.
- both "P" and "G" may be used in the same space if the time lost for practices and games was the same.
- example: P ONE WEEK G THREE WEEKS
- if the player does not return to the team, please contact him to determine why. If it is due to the injury, check off rest of season. If it is due to other reasons estimate the time that would have been lost if he had returned to the team to the best of your (and the player's) ability.

## SECTION 9: LOCATION OF GAME

Check off which pitch the game was played on or write in the other location.

**SECTION 10: FIELD CONDITION AT SITE OF INJURY**

Indicate what the condition of the pitch was at the site that the injury occurred, despite the general condition of the pitch.

Check off all terms that apply, and write in any other terms that you feel will better describe the pitch.

**SECTION 11: DID THE FIELD CONDITION AFFECT THIS INJURY?**

Indicate if you or the player feel that the field condition **directly** influenced the cause or severity of the injury in any way.

Example: __X__YES - a player sprains his ankle after his foot gets caught in a rut

__X__YES - a player sprains his knee when tackled because his foot is caught in a rut and does not give

__X__YES - a player loses his footing in a wet, muddy field and his leg slides forwards causing him to strain his hamstrings

__X__NO - a player sprains his knee when tackled and his foot is pinned by another player, or there is no other extrinsic force influencing the injury

**SECTION 12: OUTCOME OF THIS GAME**

Check off the final result of the game.

**SECTION 13: OTHER COMMENTS**

Comment on any section that you do not feel adequately describes the injury.

**APPENDIX E**
**LETTERS TO EDMONTON RUGBY UNION**

Leigh Garvie,
10119-84 Ave.,
Edmonton, Alberta,
T6E 2G8

Dear (Club President),

I am planning to do a study on the incidence of rugby injuries in Edmonton. I would be looking at the numbers and types of injuries which occur during a regular rugby season, and relating these injuries to various factors such as level of skill of the player, size of the player, position played, time of injury (in game and in season), and playing field conditions.

I plan to collect data on the injuries occurring in first division of the men's Edmonton Rugby Clubs, as well as the senior Edmonton Representative Squads.

I would appreciate the co-operation of your club in this study. If you are willing to have your club participate, please sign the enclosed consent form and return it to me at your earliest convenience. Planning for the study has begun and I will need to know who will be involved by April 1989.

Involvement in the study will mean that your team therapist will be required to complete questionnaires on all injuries that occur during the season for the above teams of your club. The therapists have been contacted already and are willing to participate. They will need the co-operation of the players to ensure all injuries are recorded. All information collected will be confidential, and no names of players or clubs will be used outside of the data collecting process.

If your club does not have a team therapist, I would ask that a club member be responsible for the completion of the questionnaires. I will train them in how they are to be completed. Whenever possible, the therapist of your opposing team will complete the questionnaires at games, and do the necessary assessments of the injuries. If there is no therapist available, I will contact the injured player to assess the injury and do the follow-up, so the member will only have to complete sections that he feels comfortable with.

If you have any questions about this study, please contact me.

Thank you for your involvement.

Yours Truly,

Leigh Garvie

Leigh Garvie,
10119-84 Ave.,
Edmonton, Alberta,
T6E 2G8
433-3029
April 7, 1989

Rick Melia,
Edmonton Senior Representative Rugby Club,
5920 - 107 St.,
Edmonton, Alta.
T6H 4S7

Dear Rick,

As we have previously discussed,I am planning to do a study on the incidence of rugby injuries in the Edmonton Rugby Union. I would be looking at the numbers and types of injuries which occur during a regular rugby season, and relating these injuries to various factors such as level of skill of the player, size of the player, position played, time of injury (in game and in season), and playing field conditions.

I plan to collect data on the injuries occurring in first division of the men's Edmonton Rugby Clubs, as well as the senior Edmonton Representative Squads.

I would appreciate the co-operation of your club in this study. If you are willing to have your club participate, please sign the enclosed consent form and return it to me at your earliest convenience. Planning for the study has begun and I will need to know who will be involved as soon as possible.

Involvement in the study will mean that I, as your team therapist will be completing questionnaires on all injuries that occur during the season for the club. I will need the co-operation of the players to ensure all injuries are recorded. All information collected will be confidential, and no names of players or clubs will be used outside of the data collecting process.

If you have any questions about this study, please contact me. I will be in contact with you by telephone in the near future.

Thank you for your involvement.

Yours Truly,

Leigh Garvie

Leigh Garvie,
10119 - 84 Ave.,
Edmonton, Alta.,
T6E 2G8
April 7, 1989

Don Whidden, Chairman,
ERU Referees Society,
3211 - 114 St.,
Edmonton, Alta., T6J 4B1

Dear Don,

I am planning to do a study on the incidence of rugby injuries in Edmonton for the 1989 season, for my thesis for my Masters in Sports Physical Therapy. I will be looking at the numbers and types of injuries that occur during a regular season of play of first division teams of the ERU clubs, and the senior representative squad. I plan to relate these injuries to various factors such as level of skill of the player, size of the player, position played, time of injury (in game and in season), phase of play in which the injury occurred, and playing field conditions.

Letters requesting co-operation and consent forms have been sent to each club in the Edmonton Rugby Union, as well as to the ERU executive.

I would appreciate your encouragement of co-operation on the part of the referees. Completion of the questionnaires (by the therapists or a club member), should not interfere with the playing of the game (delays), but on occasion there may not be a physiotherapist in attendance. In these cases I would like to ask that the referees make a note of any injuries that have occurred in their game by player name (or number or position) and team, so that I may follow-up the injury and complete a questionnaire on them. Forms will be provided for the referees to record this information on in their dressing room, if they agree to do so.

It is important for the validity of the study that we include data from all games for these divisions. I know that the referees have many demands on them during the games, so will endeavour to make this as little a burden on them as possible. Please contact me to discuss this further.

Thank you for your interest and co-operation in this project. I know that improving the safety of rugby is a concern of yours, as well as mine.

Yours Truly,

Leigh Garvie

Leigh Garvie,
10119-84 Ave.,
Edmonton, Alberta
T6E 2G8
March 25, 1989

Edmonton Rugby Union Executive,
Ms. Laura Jackson, President

Dear Laura,

I am planning to do a study on the incidence of rugby injuries in Edmonton for the 1989 season. I would be looking at the numbers and types of injuries which occur during a regular season of play of men's first division teams. I plan to relate these injuries to various factors such as level of skill of the player, size of the player, position played, time of injury (in game and in season), phase of play in which the injury occurred, and playing field conditions.

I plan to collect this data on all the injuries occurring to this division of all of the Edmonton Rugby Union clubs as well as the Senior Men's Representative Squad.

Please find enclosed a copy of the letter and consent form I will send to each club, requesting their participation, as well as the introductory section of my research proposal outlining the study in more detail.

I would appreciate the endorsement of the ERU in this endeavour, and would appreciate it if you could write a brief letter of your support that I could enclose it with my letters to the clubs, to encourage their co-operation with the study.

I would also appreciate your encouragement of co-operation on the part of the referees. Completion of the questionnaires should not interfere with the playing of the game (delays), but on occasion there may not be a physiotherapist in attendance. In these cases I would ask that the referees make a note of any injuries that have occurred in their game (by player name, or number, or position, and team) so that I may follow-up the injury and complete a questionnaire on them. Forms will be provided for the referees to record this information on.

I believe this study will benefit the ERU, as we will be developing a baseline of incidence of injuries which occur. This will allow future evaluation of any law changes or other changes the ERU or CRU make regarding their effectiveness. If the executive has any specific areas they would like me to investigate during this study, please let me know before the season begins and I will incorporate them into the study if possible, or plan future studies for them.

I plan to apply for funding for the expenses of this study, but at present there are none. As the ERU has many financial obligations, I do not expect to receive any funds from you, but would appreciate any services which you feel you can provide (photocopying of questionnaires, circulation of notices, etc).

Thank you for your interest and support in this matter. I would ask that your letter of support be written as soon as possible, to allow enclosure in my letters to the clubs and grant applications which should be sent out in early April.

Yours Truly,

Leigh Garvie, BSc(PT)

Leigh Garvie,
10119-84 Ave.,
Edmonton, Alberta
T6E 2G8
March 25, 1989

Canadian Rugby Union Executive,
Barry Giffen, President,
10250 - 133 St.,
Edmonton, Alta., T5N 1Z7

Dear Barry,

I am planning to do a study on the incidence of rugby injuries in Edmonton for the 1989 season as my thesis for my Masters in Sports Physical Therapy. I would be looking at the numbers and types of injuries which occur during a regular season of play of first division teams. I plan to relate these injuries to various factors such as level of skill of the player, size of the player, position played, time of injury (in game and in season), phase of play in which the injury occurred, and playing field conditions.

I plan to collect this data on all the injuries occurring to these divisions of all of the Edmonton Rugby Union clubs as well as the Senior Men's Representative Squad.

I have sent an introductory letter and consent form to each club, requesting their participation, as well as a letter and copies of the above to the Edmonton Rugby Union Executive, requesting their support for this project.

I would appreciate the endorsement of the CRU in this endeavour, and would appreciate it if you could write a brief letter of your support that I could enclose with my thesis.

I believe this study will benefit the CRU, as we will be developing a baseline of incidence of injuries which occur, including the nature of these injuries in Canadian Rugby. This will allow future evaluation of any law changes or other changes the ERU or CRU make regarding their effectiveness. At present, all literature is based on studies done on European, African, Australian or New Zealand players. If the executive has any specific areas they would like me to investigate during this study, please let me know before the season begins and I will incorporate them into the study if possible, or plan future studies for them.

At present, I have not been given any funding for the expenses of this study. I do not know if the CRU has access to any funds to support this type of research, but if you do, I would greatly appreciate being allowed to formally apply for

funding. The expenses are not great (see enclosed budget in the thesis proposal), but I would like to be able to provide an honorarium for the raters involved in gathering the data for me.

Thank you for your interest and support in this matter. I would appreciate your letter of support as soon as possible.

Yours Truly,

Leigh Garvie, BSc(PT)

## APPENDIX F
## CONSENT FORMS

**TITLE:** THE INCIDENCE OF RUGBY INJURIES IN CANADIAN PRAIRIE RUGBY

**INVESTIGATOR:** LEIGH GARVIE
University of Alberta, Edmonton, Alberta

**PURPOSE:** The purpose of this study is to establish a baseline of information on the injuries that occur in rugby in our geographical area and relate the findings to some causative factors that might provide insight into changes that can be made to make rugby safer.

**CONSENT:**

I,_____ representing the _____ Rugby Club of the Edmonton Rugby Union, as (position)

_____ agree to the participation of our club in the above named study. We understand that data will be collected on all injuries occurring to the first division members during practices and league games for the 1989 rugby season.

We understand that there will be no interference of the study with the players ability to be involved in games or practices, and that all recorded information will be kept confidential.

We agree to encourage the members of the divisions involved in the study to co-operate with the team therapist recording the data to enable to record all relevant data.

We authorize the above investigator to retain any data collected in this study for future use with the guarantee that our identity will be kept confidential.

We understand that our participation in this study is voluntary and that we may withdraw from the study if we so choose.

All questions that we had about the study have been answered to our satisfaction.

_____ _____
Authorized member of Rugby Club Date

_____ _____
Witness Date

_____ _____
Researcher Date